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AMERICAN RAILWAY JOURNAL.

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THE NEW BREAKWATER, now under construction by the government at Buffalo, N. Y., under the charge of Maj. Thos. W. Symonds, Engineer Corps, U. S. A., will be the largest in the world. The original breakwater was commenced in 1868, with a projected length of 4,000 ft.; this was increased to 7,600 ft. by the project of 1874, and the work was finished in 1894. The enclosed outer harbor thus formed by the breakwater and the sand-catch pier, was 1½ miles long. The new breakwater now being built will be 12,500 ft. long, making a total length of 20,100 ft. from the lighthouse to Stony Point. The nearest approach to this construction in length, said Maj. Symonds, in a late address before the Buffalo Real Estate Exchange, is the celebrated breakwater at Cherbourg, France, which is 12,200 ft. long, cost $10,000,000 and was 70 years in building.

AN ARTIFICIAL HARBOR AT DOVER, ENGLAND, has lately been ordered by the British government. At present Dover is on an open coast, with an admiralty pier built out into the Channel, and a commercial harbor has been under construction for some years which includes an area of about 75 acres on the east side of the pier. The new plan as approved will include the extension of the admiralty pier about 2,000 ft. and the building of a second pier 3,320 ft. long 1½ miles to the east of the old one, and the construction of a breakwater, 4,200 ft. long, between the ends of these two piers. The enclosed area will cover 610 acres, with 315 acres outside of the 30 ft. line. The piers will be built of masonry resting upon 40-ton concrete blocks. It is intended as a harbor of refuge, and as a coaling station and rendezvous for battleships.

THE HAVANA FLOATING DRY-DOCK, built in England and towed to Havana at an estimated total cost of nearly $1,000,000, sunk in the Bay of Havana on Dec. 8. No cause is given for its disappearance; and rumor is divided upon incompetent supervision, Cuban conspirators and fraud on the part of the English builders.

THE TEN U. S. NAVAL DRY DOCKS have the following general dimensions:

	Length.	Breadth.	Depth of sill at high water.
Boston	396.5	60	25
Brooklyn	389.3	66	25
Brooklyn	500	85	25.5
Brooklyn	670	105.2	28
League Island	500	85	25.5
Norfolk	331.8	60	25
Norfolk	500	85	25.5
Port Royal	496	97	26.5
Port Orchard	650	92.7	30
Mare Island	513	79	27.5

In sailing to San Francisco, by way of Cape Horn, a U. S. war vessel might use one of the four dry docks at Rio Janeiro, the largest of which is the Sande Point dock, 520 ft. long, 70 ft. wide and 25 ft. deep over the sill. At Montevideo the docks only provide for 17 ft. draft; and at Talcahuano, Chili, is a stone dock 545 ft. long, 80 ft. wide and 28 ft. deep. It is said that of the 748 dry docks in the world England owns about 60%; 240 of these being in England, 30 in Scotland and 18 in Ireland. Europe has 302 docks divided among 80 cities; Asia has 76, in 27 cities, and there are 22 docks in Oceanica and Australasia. The Liverpool docks, the largest in the world, cover 1,620 acres, with 36 miles of quay lines. The London docks cover 700 acres, and at Southampton is the largest single graving dock in the world; 751 ft. long, 88½ ft. wide and 28½ ft. deep on the sill.

A 16-IN. COAST DEFENSE GUN is being constructed for the War Department at the Bethlehem Iron Works, Bethlehem, Pa. This enormous gun will be placed somewhere in New York harbor, very likely in a turtle back turret built upon Romer Shoals, which are almost directly in the center of a line drawn between Norton Point, Coney Island and Sandy Hook light. Mr. J. F. Meigs, under whose direction the gun is being constructed, calculates that the striking energy of the projectile propelled by a 1,000-lb. charge of powder will be 60,000 ft.-tons. This is approximately equal to the shock which would result were a 6,000 ton steamer brought to a sudden stop while running at a speed of 16 miles per hour. The range of the gun will be over 16 miles, and should the present plan be carried out New York will eventually be protected by 14 such cannon. The following table, taken from an article by Lieut. G. S. Carden in "Harper's Weekly" for Dec. 11 will afford an excellent idea of the size of this new weapon:

	Calibre. in.	Wt. of gun. tons.	Length. ft.	Wt. of shell. lbs.	Wt. of powder charge. lbs.
United States	16	126	49.1	2,350	1,000
German..	16.5	120	45.9	2,204	903
Italy..	17	104	40.75	2,000	900
England	16.25	110.5	43	1,800	960
France	16.54	74.2	32.5	1,719.6	595.2

A CHRONOGRAPH for recording exceedingly small intervals of time, such as a millionth of a second or less, is described in an article in the November issue of the "Journal of the Franklin Institute," entitled "A Photographic Impact Testing Machine for Measuring the Varying Intensity of an Impulsive Force." The machine has been used to record autographically the compression by a blow of a cylindrical piece of copper. In one case a 33-lb. weight fell 15 ins. and produced a permanent compression of 0.1658-in. in a copper cylinder, the time consumed in producing the compression being 0.0030317-second. The machine produces by photography a curve showing the progress of the compression. The chronograph consists of a rotating cylinder, with a surface velocity of about 100 ft. per second, on which is photographed a pencil of light, which is passed through a hole in the end of a rapidly vibrating tuning fork. The delicacy of this instrument is far greater than that of the ordinary tuning fork chronograph in which the record is made on a surface blackened by smoke.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a locomotive explosion on the Chicago & Erie R. R., about 7 miles east of Lima, O., on Dec. 3, which badly injured the engine driver, fireman and a brakeman, and blockaded traffic for several hours. The engine was pulling a freight train up a grade when the explosion occurred. No reason is assigned for the explosion.——A freight wreck on the New York Central & Hudson River R. R. on Dec. 12 resulted in the injury of the three employees, including the engine driver and fireman. The wreck was caused by a large stone which had fallen from the side of a cut and lodged on the track. Sixteen cars were derailed, and the roadbed and both tracks were torn up for a distance of 250 ft.——A rear end collision between two freight trains occurred Dec. 12 in the Vosburg tunnel, on the Lehigh Valley R. R. Both engines and sixteen freight cars were derailed and caught fire shortly after the collision. The trainmen escaped from the tunnel with difficulty, but no one was seriously injured. The fire departments from Wilkesbarre and Towanda were called upon to extinguish the fire, which they succeeded in doing after working all day.——Collisions on the Manhattan Elevated Ry., of New York, during the heavy fog of Dec. 9, resulted in three persons being severely injured and a number of others being more or less bruised.

STEEL FRAMES FOR CARS are the subject of an investigation which is being made by a committee of the Master Car Builders' Association, and this committee desires to obtain information from members of the Association and others upon the following questions:

(1) If you have had any steel car frames in use, please describe all the important facts about them which your experience has brought forth, and furnish working drawings illustrating the frame.
(2) Which do you consider preferable for the members of the car frames, rolled shapes of standard commercial sizes or special pressed shapes?
(3) Which do you prefer, a car frame made entirely of steel or a composite frame made of steel and wood?
(4) What parts do you recommend be made of wood?
(5) What is your opinion of the advisability of using truss rods under side sills of steel car frames, and give the reasons for your opinion
(6) Do you recommend that the draft gear of steel car frames be located between center sills and firmly secured to them, or the use of independent draft timbers below the center sills, similar to the construction which is now generally used on wooden cars?
(7) Which do you recommend, wooden or steel side and end sills, and what are your reasons therefor?
(8) Please give maximum light weight of car per ton (net 2,000 lbs.) you would recommend for each ton of paying freight.
(9) Recognizing the fact that steel car framing will be used in cars of very large capacities, what type of center plate would you recommend, and what maximum bearing pressure per square inch would you recommend for carrying the car and lading?
(10) What type of side bearing would you recommend for cars of large capacities with steel car framing?

The information should be addressed to Mr. A. E. Mitchell, 21 Cortlandt St., New York, N. Y.

IMPROVEMENTS ON THE BALTIMORE & OHIO R. R., made since the property was placed in the hands of receivers, are described in the report for the year ending June 30, 1897. The improvements include many new bridges capable of carrying the greatly increased engine and train loads, the rearrangement of yards and terminals to facilitate the handling of freight trains, and the reduction of grades and curves at several points to enable heavier trains to be hauled at less expense. Besides all this, great amounts have been expended in lining tunnels, purchasing new rails and track material, double tracking, making additions to shops and stations, and large additions to the locomotive and rolling stock equipment. Its reduction of the grades and curvature between Baltimore and Cumberland, 192 miles, has enabled the train loads between these points to be increased at least 30 per cent. Across North Mountain, grades of 10 ft. per mile (equated for curves) have been substituted for grades of 42 ft. per mile, while 136° of curvature have been entirely eliminated. At another point, a series of reverse curves has been replaced by tangents and easy curves, while the objectionable "Seven Curves" have been replaced by long tangents and 3° curves. These improvements are, no doubt, a factor in the reduced cost of locomotive service, which was lower on nearly every division in spite of an increase in mileage, the cost being 15.72 cts. per mile run for 31,640,000 miles, as compared with 16.38 cts. per mile run for 29,203,000 miles in 1896.

THE TAKU-TESLIN RAILWAY ROUTE to the head of navigation on the Yukon River, in Alaska, is being promoted by the Yukon Mining, Trading and Transportation Co., of Wilmington, Del. The line surveyed and reported upon by Prof. Wm. A. Pratt, M. Am. Soc. C. E., is described as follows in a report made to the company: It starts at Taku Inlet, 900 miles from Seattle, and follows up the Taku River and the Na-Ka-Na River to Teslin Lake, 157 miles in all. This lake is claimed to be the head of navigation on the Yukon River and is 492 miles from Dawson City, on the Yukon. The waters of Lake Teslin are 2,600 ft. above sea level, but a summit of 3,000 ft. must be passed in reaching it, and the difference of level in 12 miles at one part of the line is 2,000 ft. Over this a 3% grade is proposed. The country is described as requiring no tunnels or other heavy engineering work, and only two bridges of any size. As compared with the route to Dawson City via St. Michael, the saving in distance claimed is 2,804 miles.

ARTICULATED LOCOMOTIVES on the Haggans system have been built by F. Weidknecht, of Paris, for service on the Volo & Lechonia Ry., in Thessaly. The railway has a gage of 24 ins., with steep grades and sharp curves. The locomotives are tank engines, with a rear pair of coupled axles carried in the main frame of the engine, and the front pair of coupled axles carried in a swiveling truck frame. On each side, above the frame, is a horizontal cylinder whose connecting rod drives a vertical rocker arm, to the lower end of which is attached the connecting rod which drives the leading axle of the rear pair. A coupling rod on the rocker drives a second rocker which carries a connecting rod driving the rear axle of the front pair. To allow of the swiveling of the track, ball and socket joints are required for some of the rods. There are seven rods and two rockers on each side, exclusive of the rods of a modified form of Walschaert valve gear. In our issue of Feb. 9, 1893, we described the Cowles articulated locomotive, which had two driving trucks, with a single pair of horizontal cylinders mounted on the middle of the frame, and having piston rods through both ends of the cylinders. The four connecting rods drove two crank axles journaled in the main frame, each of these axles passing through the hollow axle of the main pair of drivers, the inner and outer axles being connected at the middle by a universal joint. The hollow axle was large enough to allow it to follow the radiating movement of the truck on curves without striking the interior rigid axle. Annular crank arms on the hollow axles carried the ends of the coupling rods. We have several times had occasion to refer to the complications of mechanism with which foreign locomotive builders are fond of encumbering their engines, and our views in this respect are endorsed by the "Engineer," of London, in its remarks on the Haggans engine, as follows:

All this is exceedingly ingenious and beautiful, and we take the word of our contemporary (Portefeuille Economique des Machines) for it that the system works well. It is certainly one to delight the heart of a Frenchman. Just look at the number of moving parts, of joints to be oiled, of traps for dirt! Consider the joy of seeing it all going together, of working the brakes, the injectors, the whistle, the reversing gear all at the same time, and oh! climax, paragon, zenith of delight, to be able to do it all going round a curve of thirty meters with a load of 60 tons behind you, and la mere waiting for you at the corner!

THE CORNHOUSE BRIDGE, BERNE, SWITZERLAND.*

(With two-page plate.)

By Elmer L. Corthell, Dr. Sc.; M. Am. Soc. C. E.

On the return of the writer from Berne in the summer of 1895, he wrote an article describing the proposed bridge over the river Aare at Berne. This article was published in Engineering News, Dec. 19, 1895. The bridge is now well on toward completion, and in an interesting stage of the work. Reference is made in the present article to that of Dec. 19, 1895. In that there was a map of the city showing the location of six bridges already existing, and of the proposed bridge; also some photographic reproductions of most of the present bridges and a photograph of the plan proposed for the Cornhouse Bridge. A clear idea of the facts now to be presented requires a re-reading of the former article in order to avoid reproducing it here.

The general plan of the structure, shown in the former article, was selected by the Commission from several plans submitted in the International competition. Some of the features which led to the selection of this plan were—the general pleasing architectural appearance, the small arches of the approach spans, the bifurcated piers, the great towers crowned with obelisks 36 ft. high above the roadway, and the abutments with pavilions, harmonizing admirably with the great main arch. The finely proportioned stone piers give the structure a solid and monumental appearance, while the light steel work seems to the eye to be a bold spring across the valley of the Aare, 160 ft. deep and 1,200 ft. wide. The roadway girders, too, made, for appearance sake, a uniform depth of 4 ft. 8 ins. throughout the whole length of the work, give an architectural finish to that part of the structure.

The Commission required some detail modifications of the accepted general plan. The designers had used a lateral distance c. to c. of arch ribs at the crown about 4 ft. 6 ins. less than that prescribed by the Commission, and had lengthened the sidewalk brackets in order to obtain the required width of roadway. The Commission allowed this to stand, but, in order to increase the stability of the arch laterally, they required an increase of batter from 1 in 15 to 1 in 12. This, with the high parabolic curve proposed for the ribs, gave the arch a stilted appearance, so a curve between a parabola and a circular arc was adopted instead. These alterations of the superstructure required an increase in the size of the masonry and foundations.

Some of the minor features changed should also be referred to. The dimensions of some of the arch members were considered too light and also the cross bracing in the main arch members. The secondary longitudinal trusses were strengthened, posts were inserted in the triangular bracing of the principal roadway trusses, the bents supporting the latter on the arch were strengthened, and the method of attaching the sidewalk brackets to the main members was improved. The expansion devices in the roadway were improved, the buckle plates were increased from 3-16-in. to ¼-in. thick, and the corrugated sections supporting the sidewalks were made heavier and placed closer together. Other changes were also introduced with a view to making the best possible design in point of strength, stiffness and appearance. With these and a few other minor changes in superstructure and substructure, the illustrations accompanying this article show the plans on which the work is built.

The photographs show the present condition of the work. American engineers will be struck with the forest of poles in the falsework for the erection of the main arch. This is in accordance with the general method in Europe, principally due to the fact that large timber is not available except at great expense. In the building of houses, also, these long, slender poles are used around and in the building and are tied together with rope.

In the former article, the peculiar character of the material through which the approach pier on the left slope had to be sunk was mentioned, as follows:

> The conditions as to soil on the Cornhouse, or city side of the bridge, are peculiar. Many years ago Berne was nearly destroyed by fire. In removing the rubbish it was hauled to the Cornhouse Square and dumped over the bank of the river. The test pits sunk on the bridge approach show how deep this material is, and the depth of unstable material to be penetrated in putting down the approach piers. This material indicated by the profile is as follows: The filling of rubbish from the fire is over 50 ft. thick; then comes loam about 15 ft., and then loam with coarse sand and gravel about 25 ft., and then gravel down to the molasse, a geological formation of great depth found in Switzerland.

It would have been very troublesome to open an excavation down through this material. It was decided, therefore, to build the pier from the top downward instead of from the bottom upward; that is, by a process of progressive underpinning which, to the writer's knowledge, has never before been attempted, at least under similar conditions, to a depth of 92 ft. below the surface of the ground. The credit of this novel plan is due to the contractors' engineer, Mr. Paul Simons. It was considered necessary to carry the pier down to this depth without in the least disturbing the earth about it, and to leave the natural earth pressure against the wall throughout its construction. The plan hit upon was to build from the surface downward by brick walls. The accompanying drawings show the method adopted. A sort of curb frame, of two rings of channel irons, well braced, held in place a series of short channel irons, which latter were set around the periphery of the excavation much like ordinary sheet piling, and each carried a rack attachment. On top of these short sections of channel iron rested short wooden planks which bore upward against the finished wall as it progressed. The successive operations in sinking the brickwork were then as follows: A hand lever with a gear fitting the rack on the sheeting sections was applied to one after another of these sections, forcing them downward into the ground and away from the plank for about 18 ins. until a depth of from three to four feet had been cleared. Then the earth was excavated in this space, the plank lowered to its new position, and the brick wall filled in, using rather quick-setting Portland cement mortar. Successive sections of wall were thus built until a complete ring, 18 ins. deep, was finished, and the entire foundation was carried down in this manner. When the walls had reached the proper depth, the interior space was filled with concrete. The dimensions of this pier at the bottom are 15 ft. 5 ins. × 27 ft. 2 ins. When the pier reached the bottom, it was found that the settlement during this novel construction was practically nil.

The main tower on the left bank (city end of the bridge), went down to the elevation proposed and rests on the material which the original test pits indicated. The main tower on the right bank, however, was less fortunate, and the development of bad material and uneven strata, and the deeper foundations consequently required, added $60,000 to the estimated and contract cost of the work. From the test pit it was expected that the footings would rest on the hard soil below the marine with a maximum load of 5 tons per sq. ft. When the whole pit was opened, this stratum was found to be in an entirely unexpected condition. In a length of 85 ft., there was a difference in level of 39 ft. But this was not the worst feature. There was also a great lack of homogeneity of material. While the upper and lower layers were hard and firm, there was found between them a sandy, water-bearing stratum. The Commission was called upon to say what ought to be done. They decided to increase the area of the foundations so as to reduce the load to 3½ tons, and to drive in the foundations piles of American southern pine, which were shipped from Pensacola, Fla. The photograph shows these piles as driven. They penetrated the bottom of the foundation about 30 ft., and were cut off about 3 ft. above the bottom of the pit. The entire space was then filled with concrete to a depth of 30 ft.

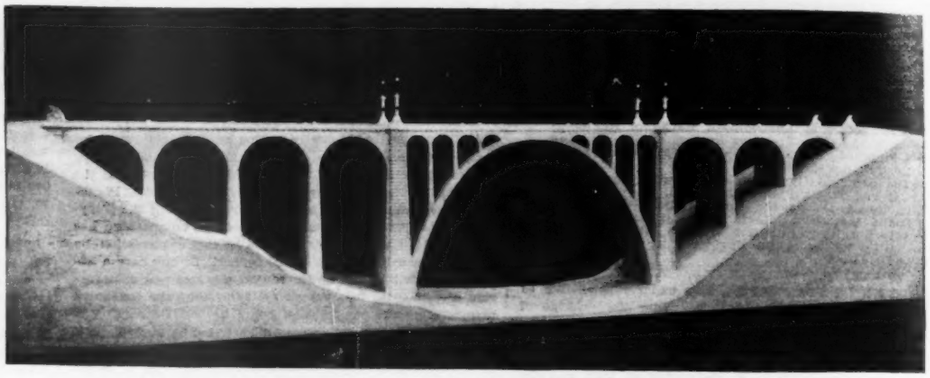


FIG. 8.—THE ACCEPTED DESIGN FOR THE LORAINE BRIDGE, BERNE, SWITZERLAND.
Robert Moser and Gustave Mantel, Engineers, Zurich, Switzerland.

Exclusive of the falseworks, which are estimated to cost $23,400, the steel structure erected, including ornamental work, handrail, candelabra, etc., will cost 3.82 cts. per lb. In the article in Engineering News of Dec. 19, 1895, the writer discussed the question of the ability of United States manufacturers to compete for such structures in Europe. The following facts bear on this question: The freight to Berne, from New York to Philadelphia—ocean and rail—is about 0.46 ct. The duties on finished work are 0.35 ct., leaving about 3 cts. to cover cost of material, manufacture, delivery to ship side from the works, insurance, unloading, hauling a little over one-half mile at Berne, erecting and painting. As finished work is now being delivered at ship's side at New York at less than 2 cts. per lb., there would seem to be some working margin, even if the rather peculiar character of this bridge is considered. The material need not all be finished. If imported into Switzerland in beams and channels and other unriveted parts, the duty is on "raw materials" and is practically nothing. The German manufacturers who furnish the superstructure for this bridge arrange to have a good part of the work put together in Swiss shops, so as to avoid the heavy duty; and this could be done by any American manufacturers by having a good superintendent at Berne. This plan would also lessen the expense and trouble of handling long and curved members on the small freight cars of Europe, and on board ship; and it would lessen the danger of injury in handling at the ports. It must be borne in mind, however, that style, details and many minor features of specifications, as well as the character of the material itself, is different in Europe from what it is in the United States, and particularly in reference to pin-connected work, against which both British and Continental engineers have still a strong prejudice. It is to be hoped, however, that the very excellent and complete work on American Bridges, recently published by Mr. Louis Renond, Engineer Ponts et Chaussees, of 34 Boulevard du Contrascarpe, Paris, will dissipate the erroneous views on this point. This is a work that ought to be in the hands of every European bridge engineer, and American engineers will find it one of the best, if not the best, compilation, comparison and dis-

*The line drawings accompanying this article are, with two exceptions, redrawn from illustrations in the "Schweizerische Bauzeitung." The perspective views are from photographs sent us by Mr. Corthell, and Fig. 4 is from a sketch made by him.—Ed. Eng. News.

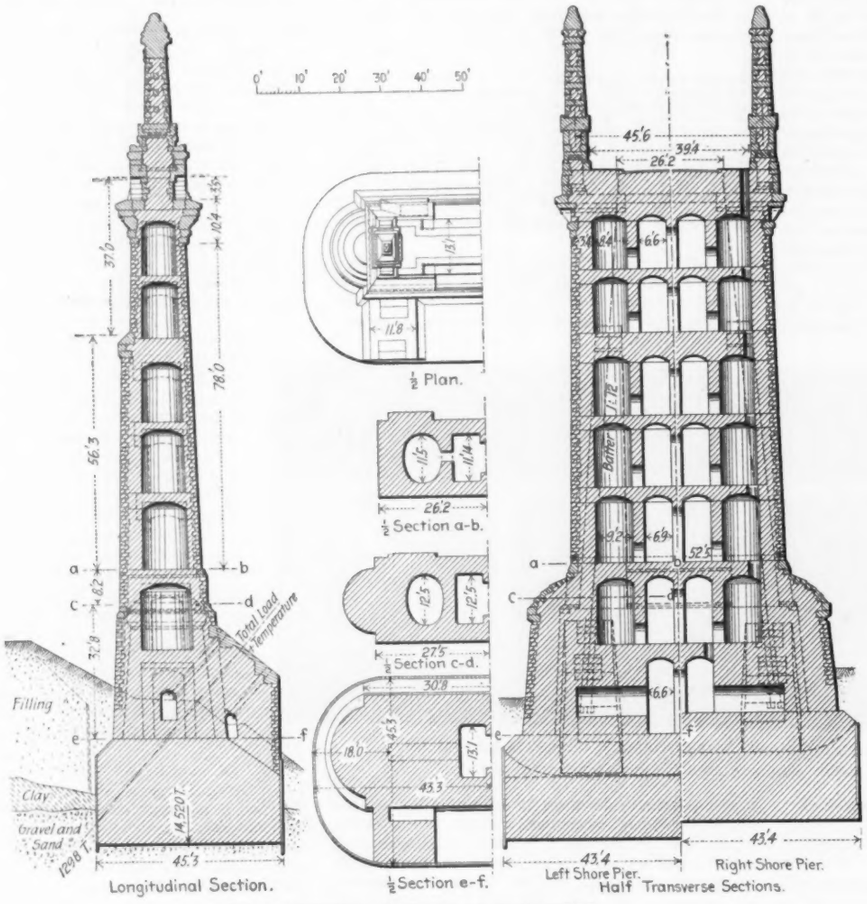


FIG. 3. GENERAL DETAILS OF MAIN PIERS.

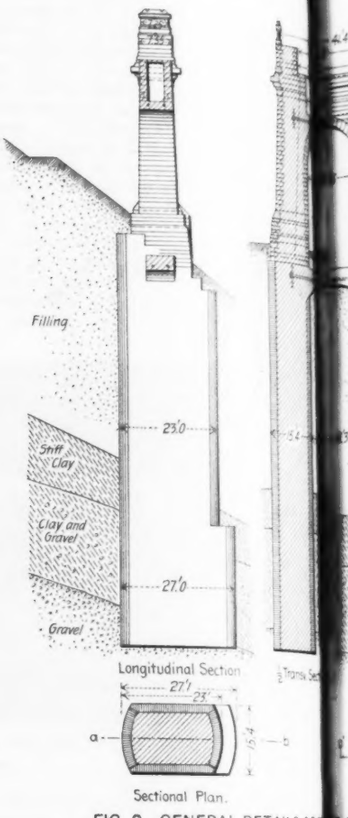


FIG. 2. GENERAL DETAILS OF [illegible] AP

THE CORNHOUSE BRIDGE [illegible] BI

Arthur & Hermann, Bonstetten[illegible]d
Desi[illegible]rs.

Theodor Bell & Co., Kriens, Lucer[illegible]an
Contr[illegible]ors

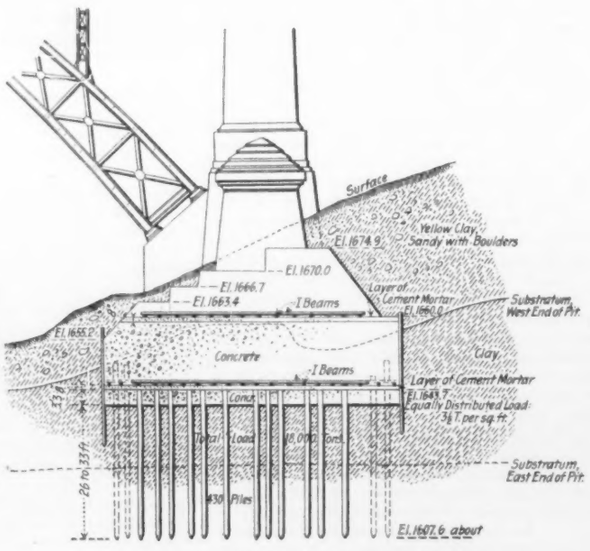
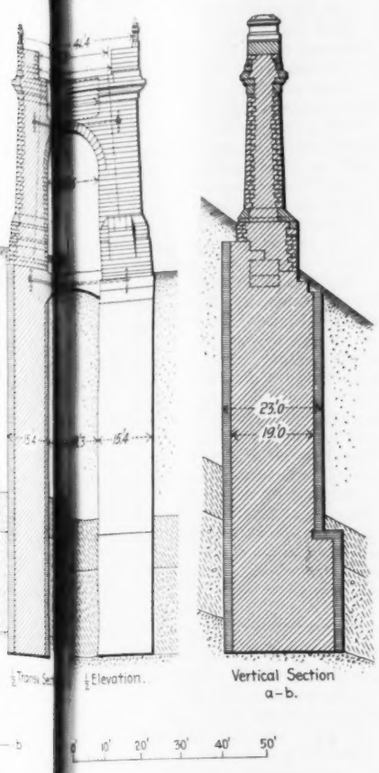


FIG. 4. SKETCH SHOWING FOUNDATION FOR MAIN PIER ON RIGHT BANK.

FIG. 6. VIEW OF FALSEWORK FROM THE VA[illegible]



TAILS OF D APPROACH PIER, CITY SIDE.

BRIDGE BERNE, SWITZERLAND.

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Desi rs.

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M THE VA BELOW.

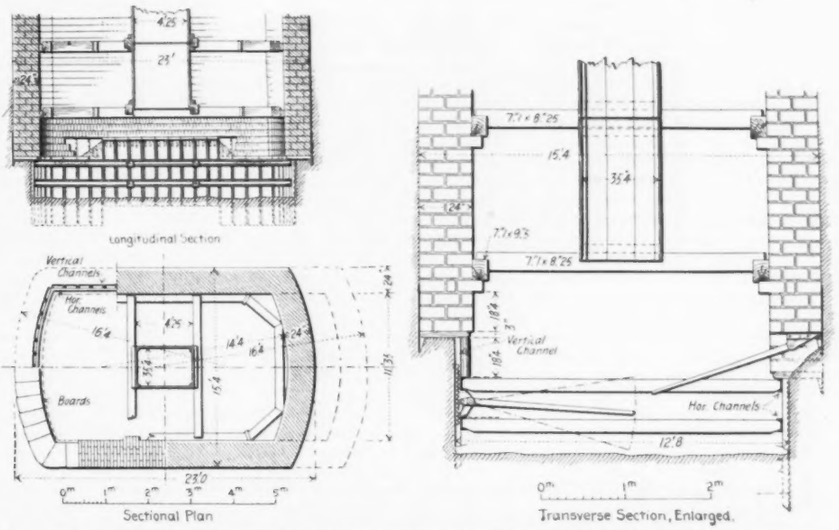

FIG. 1. METHOD OF SINKING FOUNDATIONS FOR DEEP APPROACH PIER, CITY SIDE.

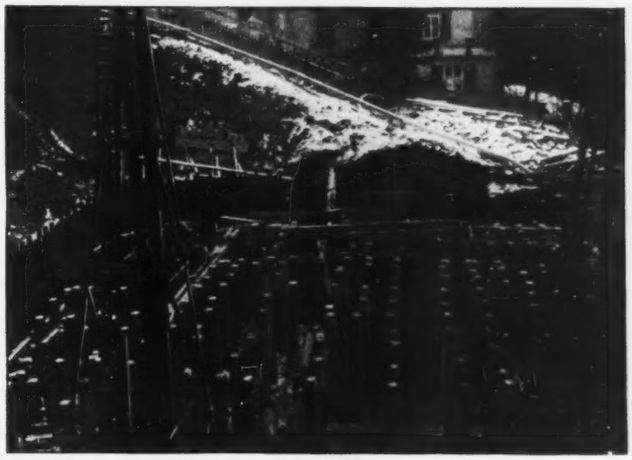

FIG. 5. VIEW OF PILING IN FOUNDATION FOR MAIN TOWER.

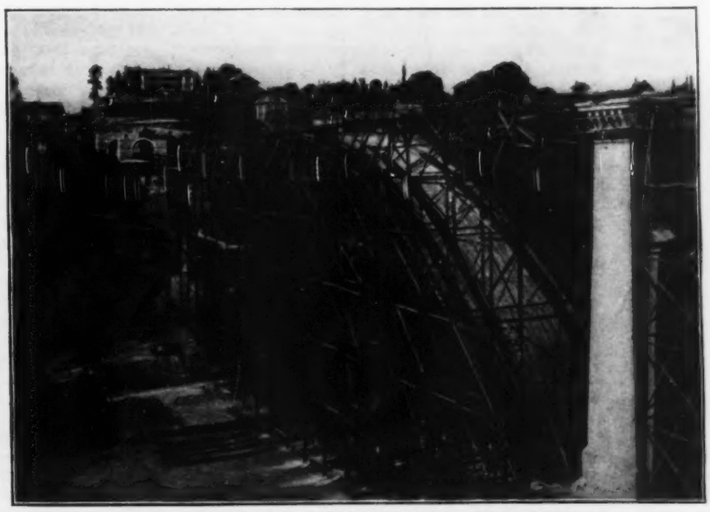

FIG. 7. VIEW OF FALSEWORK FROM THE LEFT BANK.

cussion of American and European methods ever published.

This article would not be complete without reference to another and much more unique design of a proposed bridge over the river Aare, within sight of the Cornhouse Bridge. Referring to the previous article in the issue of Dec. 19, 1895, the reader will find a photographic view of the Loraine railroad bridge, a short distance below the Cornhouse Bridge. This deck railroad bridge carries the street traffic on the lower chord, much to the inconvenience of this traffic, as the clear space for vehicles and pedestrians is very narrow and both vehicles and pedestrians must move in the same space. A new Loraine bridge, entirely devoted to street traffic, has been under consideration for some time. The same Commission that has in charge the Cornhouse bridge has had before it competitive designs for the Loraine bridge and have accepted that of Messrs. Rob. Moser and Gust. Mantel, engineers, of Zurich. As will be seen from the photograph of the model that accompanied the plans, this bridge is to be entirely of masonry. When the dimensions are considered, it will be seen to be one of the most interesting and, in some respects, novel structures. These dimensions are: Length, 649.9 ft.; height from low water to roadway, 137.8 ft.; length of main arch, 196.85 ft.; length of seven approach arches, 49.21 ft. each, and width of roadway, 44.62 ft. Attention is called particularly to the secondary arches resting on the main arch and carrying the roadway. The design is beautiful as well as unique.

RECENT NOTES IN WASHINGTON, D. C.

At 2:30 a. m. Nov. 25 a fire started in that end of the United States Electric Co.'s plant devoted to the various instruments, switches and equalizers used to regulate all the low tension direct current leaving the station. The exact cause of the fire is not known, but it is supposed to have been the crossing of some of the heavily loaded mains where they leave the building, or at some point back of and near the switchboard. At all events, the fire ran along the insulation of the cables to the woodwork, and in a very few minutes had destroyed the instruments and all apparatus connected with the swithboard. The instant the familiar smell of burning insulation was noticed the engines were shut off and all fires drawn, and an alarm turned in. The result of fire and the water, liberally distributed by the fire department, was a complete destruction of the apparatus mentioned, and several of the Edison bipolar generators. The fire, occurring just at the time it did, was particularly unfortunate, as the company has at present under construction an addition to their plant, which will be equipped with the most modern machinery, and in an adjoining building the Electric Storage Battery Co., of Philadelphia, Pa., is erecting for the company a storage battery plant, which will be used to even up the load and regulate the feeder system. The company's loss was largely covered by insurance, but no estimate can be formed of the loss due to the inconvenience suffered during the hours of shut down by the many customers depending solely upon electricity for light or power.

This was the second fire within a short period, seriously interfering with the business of the city, the other one being the burning of the power plant of the Capitol Traction Co. (Eng. News, Oct. 7, 1897). The site of this plant, which was considered one of the finest cable railway power plants in the country, is now a chaotic mass of brick, stone and bent iron. The complete destruction of this large plant does not speak well for slow burning construction, of which this building was a fair sample. In fact one can find several object lessons among the ruins. On one side may be found unprotected cast-iron columns and wrought-iron I-beams broken or bent in every possible manner, while at what was formerly the main engine room, the built up steel columns, protected with terra cotta casing, are as straight and sound as the day they were put up. At the place in the ruins where the office was located is a two-story brick vault used for the storage of the company's books and valuable papers. This withstood the fierce heat, and the enterprising safe firm which supplied the doors for the vault has a sign upon it, the nature of which our readers can surmise.

The Capitol Traction Co. is now changing its cable road over to the conduit electric system. This requires only the putting down of a system of ducts or conduits between the tracks, the insertion of insulators, conductor rails and feeders, and the installing of the current generating machinery. The latter is being placed in a building on the banks of the Chesapeake & Ohio Canal. This, of course, means a large amount of work, but nothing compared to what would be required to construct an entire new system, conduits and all. It is hoped to have one branch, known as the 14th St. section, running by February, with current rented from some of the suburban electric lines. The Georgetown, Avenue & Navy Yard section will doubtless have to put up with the temporary horse system a month or so longer.

The much-talked-of Columbia & Maryland Electric Ry. has changed hands again, and as the transaction carries with it the Eckington & Soldiers' Home Ry., the Belt line and others, the residents along these lines are once more living in the hopes of a modern conduit electric system. The various experiments conducted on the Eckington lines with compressed air motors have not been such as would warrant their adoption, and it is now quite certain that any change will be to the conduit electric. This is especially hoped for, since it would make a uniform track and motive power system on all the lines in the city, with the exception of the Columbia Ry., which employs a cable. However, this also will doubtless be changed in a few years.

The new city Post Office, which has been building for several years, is finished, so far as exterior is concerned, but practically all the interior work is yet to be done. While complete details of the lighting plant have not as yet been published, it is understood that there will be four compound engines, either horizontal or vertical, using steam at 125 lbs. These will be directly connected to four 120 K-W. multipolar, compound-wound generators giving 125 volts when running at 300 revolutions per minute. As each generator will have an output of 925 amperes, the normal capacity of the plant will be about 8,000 16-c. p. lamps. A portion of this will, however, be utilized for motors for different purposes. A 12-hour test, and a 25% overload test for a half hour will be required. A neat and substantial switchboard, equipped with all necessary instruments, controls a system of feeders running to marble panel boards on each floor, from which the lights of that floor will be manipulated. The wires and feeders are to be drawn into iron-armored and lined conduits, which will be laid in the cement of the floors.

Congress, at its last session, appropriated $100,000 to build, at the Washington Navy Yard, a tank for testing models of vessels. The contract for its construction was awarded to the Penn Bridge Co., Beaver Falls, Pa. At present the foundations are completed and the concrete basin nearly finished, and work is about to be started upon the walls of the building, which will be about 500 × 50 ft. with a clear headway of 13.9 ft. The tank proper is a V-shaped concrete basin, 368½ × 49½ ft., with 14 ft. clear depth. At one end is a starting basin 69¼ ft. long, while at the other end is a somewhat similar channel in which the models end the trip down the tank. On each side of the main basin will be pairs of heavy rails, firmly bolted to the concrete foundations, upon which will run a car much resembling a traveling crane. This will be driven by electric motors, taking current from a system of trolley wires alongside of the track. Upon the carriage will be mounted the various recording instruments used in the experiments. The models will be made of pine, carefully cut by a machine which will accurately reproduce the lines shown by the design, and they will be as nearly as possible 20 ft. long. As the towing carriage will at times attain a speed of as much as 23 miles per hour, a system of powerful friction and hydraulic brakes will be provided, capable of stopping the carriage from full speed in 20 ft. When finished this will be the largest and most complete testing tank in the world, and very valuable results are looked for.

An interesting sight, and one which cannot but increase the respect of the layman for engineering, since it shows the wonderful precision of machine work required in the manufacture of modern built up guns, is the shrinking of the jacket upon one of these large weapons at the gun shop of the Washington Navy Yard. The tube upon which the jacket is to be put is mounted vertically in a pit near the center of the shop, and held in position by a system of screw clamps. The jacket, whose inner diameter is slightly less than the outer diameter of the tube, has for some time been heating in a peculiar form of hot air furnace which prevents oxidization of the surface of the metal. When everything is ready the furnace top is removed and the jacket is lifted out by a heavy traveling crane. A swab is run through its interior to remove any dirt or grit and a four-pointed or star caliper on the end of a rod is thrust up through the jacket to see if the heat has expanded it sufficiently. Next the crane, guided by the operator, carries the jacket over the tube with such remarkable precision that the attendants standing below are required only to barely touch the jacket to guide it in starting upon the tube. When lined up properly the craneman lowers rapidly, two assistants with their hands protected by cloth pads turning the jacket slightly back and forth to prevent sticking. Throughout the whole operation, requiring not more than five minutes, not a word is spoken, every movement of crane or men following signals given by the superintendent in charge.

Washington, in common with many American cities, has just now a great deal of trouble with garbage disposal. During the winter months a Brown plant, erected by the contractor, when in good order, handles all the city refuse. However, this plant is not adequate during the summer months, and the surplus material has caused both contractor and commissioners considerable trouble. The contractor expresses his willingness to build covered steel scows to carry the material down the Potomac River some 18 miles, to a disposal plant which he offers to build, should the Commissioners give him a new contract for five years. The Commissioners do not care to bind the city to such an arrangement, however, for at the end of two years the present contract will expire. In the meantime events may transpire which would make it advisable for the city to build its own garbage disposal plant.

Capt. D. G. Gailliard, who is in charge of the Washington Aqueduct and water-works system of the city, in placing some 12-in. branches in various mains, using the A. P. Smith cutter, secured several interesting samples of incrustation. A 30-in. main of uncoated Scotch iron, placed by Gen. Meigs about 1860, was very badly coated, some of the tubercules projecting fully ¾-in. An uncoated 36-in. main laid in 1876 was also well incrusted, while a 36-in. coated main also placed in 1876 was fairly clean and a 48-in. coated main laid in 1884 had its interior surface practically as smooth as when laid.

A MACHINE FOR MAKING CYLINDRICAL COTTON BALES.

There are few industries of equal magnitude that have enjoyed so little progress in a mechanical way as the preparation of cotton for the market. Coming from the field the cotton undergoes two processes, the ginning to separate the seeds from the lint and the compressing and binding of the lint into bales, before it reaches the carding mills. For the first process the gin invented by Eli Whitney, and but little modified, is still the machine which is almost altogether used. The lint as it leaves the gin condenser drum is thrown into a gin press, which is simply a rectangular box, where about 500 lbs. of cotton is pressed into a bale, weighing about 12 lbs. per cu. ft. This bale is covered with jute and strapped with six or eight steel bands, and is then shipped to a central compress, where it is subjected to a pressure of some 2,000 tons and reduced to about one-half its former thickness or to a density of about 22 lbs. per cu. ft.

The chief trouble in this system of compressing

has arisen from the great thickness of the mass or layer of cotton compressed at one time. The air between the fibres in the interior of the mass cannot escape and is consequently compressed, in which state it is constantly exerting a force tending to burst the bale asunder. Sometimes, if they are poorly put on, the steel straps break, and nearly always the bale assumes an irregular rounded form, awkward to pack in cars or the hold of a ship so that movement will not take place. The presence of this air in the interior of the bale further causes it to be very dangerous in case of fire, which once gaining access to the interior of the bale is almost impossible to extinguish. This feature of cotton fires, especially on ship board, is familiar, and, as is also well known, is the cause in a great measure of the high insurance rates on cotton cargoes and cotton stored in warehouses.

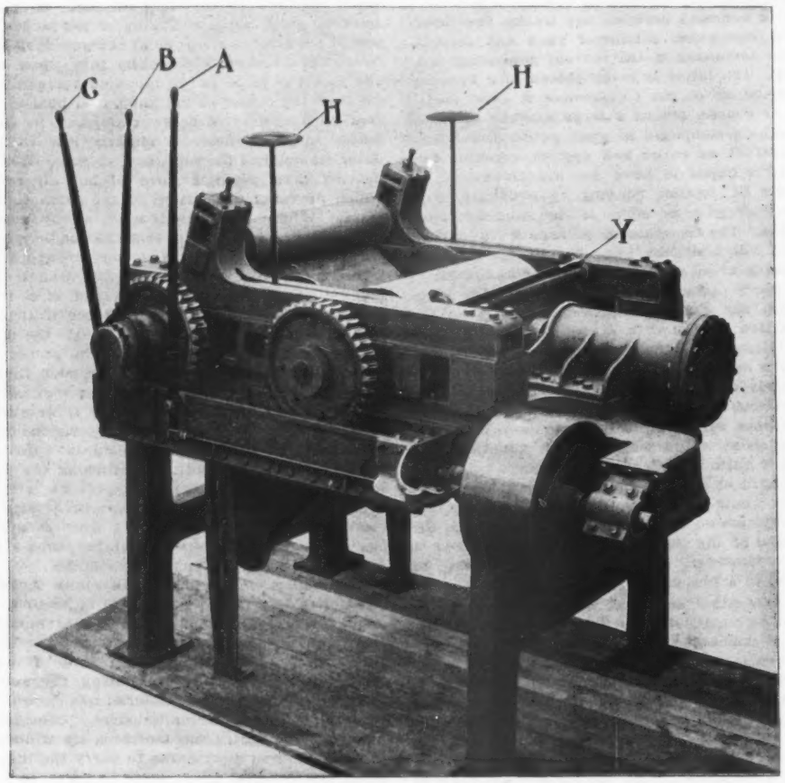

FIG. 1.—ROUND BALE PRESS FOR COMPRESSING COTTON INTO CYLINDRICAL BALES.

(A, lever to start press; B, lever to stop stationary roll; C, lever to relieve strain on screw; H H, levers holding core; Y, lever to clamp baling belt on movable roll.)

Walburn-Swenson Co., Chicago, Ill., Manufacturers.

Nothing more needs to be said to show that any method of compressing and baling cotton which will obviate the faults mentioned is a very desirable thing, and in the cylindrical bale cotton press, which we illustrate here, the American Cotton Co., of New York, N. Y., claim to have such a method. Fig. 1 is a view of the press, which is manufactured by the Walburn-Swenson Co., of Chicago, Ill., and Fig. 2 is a drawing showing more clearly the machinery and operations by which the cylindrical bale is produced. Fig. 3 is a view of the American Cotton Co.'s plant at Waco, Tex., which shows a pile of the cylindrical bales ready for delivery, and Fig. 4 shows, at a larger scale, a number of the cylindrical bales wrapped and marked for shipment.

The clearest idea of the operation of the compress is had from Fig. 2. The lint coming from the gin enters the chamber A in which the condenser drum B revolves at about 160 revolutions per minute. This drum is made exactly like the condenser drums always used in the Whitney gin, that is its cylindrical surface is wire mesh against which the lint is blown and retained while the dust is carried with the air through the netting and out at both ends of the drum. One fault of the old slow revolving condenser drum was that a bat of cotton collected on the mesh in so thick a layer that the air could not pass through it and the dust was, therefore, only partially removed. The rapid revolution of the drum B is provided to prevent this clogging of the mesh. It will be seen that the lint is blown up against the drum and remains in contact with it but a very short time, when it is thrown off and falls between the bat former aprons C C.

The aprons C C are two endless belts, which carry the cotton downward and which gradually compress it until it comes out at the bottom in a thick uniform bat. It will be seen that the thickness of this bat can be regulated by simply changing the speed of the aprons. The bat passes down the chute between the stationary roll D and the compression roll J, where it gets a preliminary pressure forming it into a solid compact layer, which passes onto the bale being formed between the two main compression rolls D E. The surface speed of these two rolls is about the same as the speed with which the bat leaves the aprons, so that the bat is neither folded nor broken, but passes perfectly straight and intact onto the bale.

The two main rolls D E both revolve in the same direction and an endless belt F passes over both rolls and underneath the bale. This belt serves a fourfold purpose. It keeps the bat from sagging underneath; it assists in starting the roll around the core; it places the covering on the bale, and finally it aids to discharge the completed bale from the machine. The idler G serves to keep the belt E taut in a manner clearly evident. The pressure on the bale is produced by the pressure in the cylinder H, the piston being connected directly with the bearings of the movable roller E. As the bale grows larger the movable roller is forced away from the stationary roller, and by checking the outflow from the end of the cylinder, any desired pressure on the bale may be had, the bale itself, in fact, preserving automatically the pressure. In order that this pressure may be uniform, the air chamber K is provided, to serve as a cushion.

The description just given explains clearly the theory and construction of the cylindrical bale cotton press. The condenser drum B and aprons C C are operated by a belt from the pulley L, and the rollers D E are operated by a worm gear actuated by a pulley and belt, as clearly shown by Fig. 1. The drawing Fig. 2 shows a double press, in which there is no stopping of the process, as by properly adjusting the paddle M the bale N is begun as soon as the bale P is finished, and the single press plant is exactly similar except, of course, that one press is removed.

In operating the round bale press the pressure column K is filled with water to a height of about the middle of the water gage class k. At this point there should be no pressure, and the proper amount of air cushion for future operation is had. When the press rollers are as close together as the distance plates will permit the pressure is fixed at 10 lbs., which is about the proper amount with which to begin the bale. The relief cock of the cylinder is set to blow off at a pressure of 200 lbs. per sq. in. The wooden core on which the bale is wound is greased with lard and wrapped with hard, smooth paper, after which it is inserted in the machine. This greasing of the roll enables it to be knocked out of the bale with a few sharp blows of a hammer. The pressure roll J having been screwed down, and the proper adjustments made in the aprons, condenser drum, and other parts, the machine is ready to be thrown into operation, and winding continues until the bale has reached the proper dimensions. The cover is then put on under pressure, lapped about 12 ins., pinned, and the bale removed from the press. The covering is then sewed at the lap and gathered at the ends of the bale, after which the

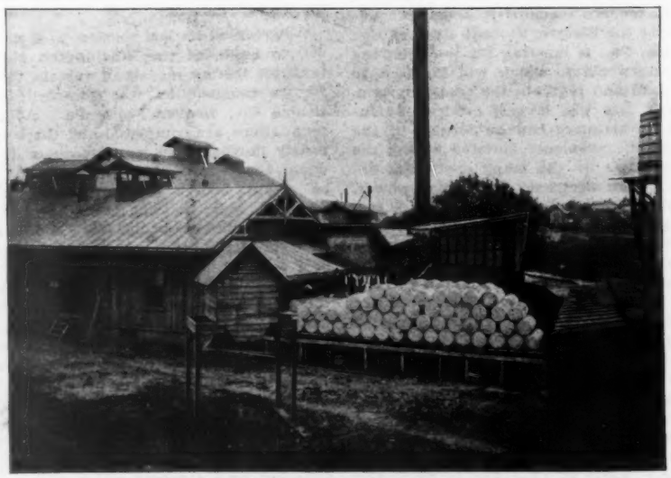

FIG. 3.—PLANT OF THE AMERICAN COTTON CO., AT WACO, TEXAS, SHOWING ROUND BALES READY FOR SHIPPING.

weighing and marking is done, the whole producing a cylindrical roll 2 ft. in diameter and 4 ft. long, of the appearance shown by Fig. 4.

The principle which lies at the bottom of the round bale method, it will be seen, is compression

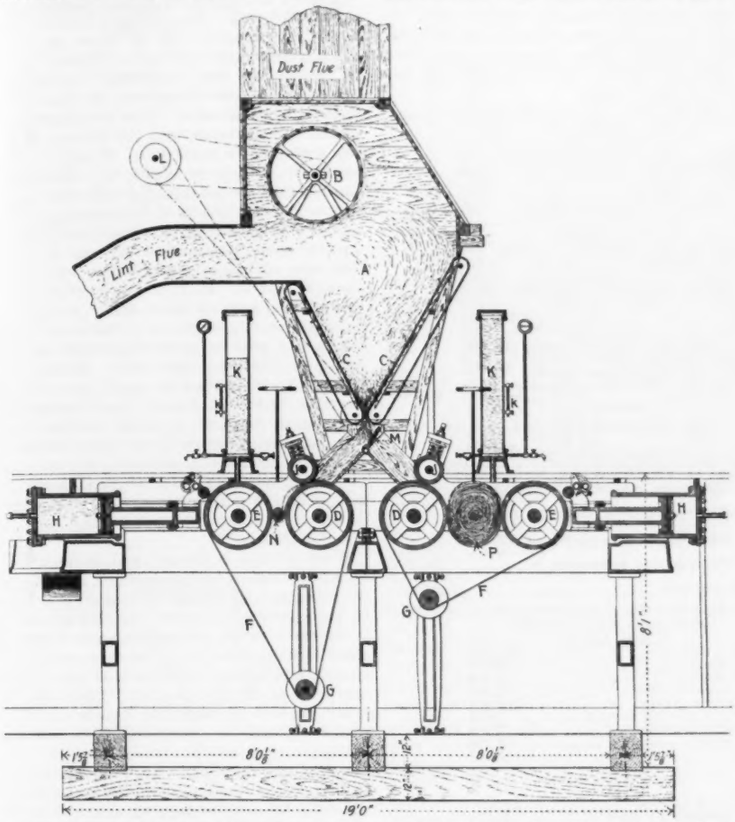

FIG. 2.—SECTION OF DOUBLE, ROUND BALE COTTON PRESS, SHOWING CONSTRUCTION AND OPERATION.

in thin layers. Several advantages are gained thereby. The mass or layer of cotton is never so thick that the air is not easily squeezed out of it by the pressure. There being no air confined in the bale under pressure, there is no tendency of the bale to expand, and there is also a minimum of oxygen upon which fire can feed. This density, which, of course, results in a reduction in the volume occupied by a given weight of cotton, is, moreover, gained without ever exceeding a pressure of 200 lbs. per sq. in., and there is consequently a reduction in injury to the fibre by crushing. The amount of tare per bale is about 0.75% of the total weight, while in the old form of bale it is about 5% of the total weight. The cotton can be unwound from the bale in a continuous bat, as is done with a roll of cotton wool. A bale is made every six or eight minutes, and when made is ready for shipment to any distance without the delay or expense of recompression at a central compressor, which is necessary with the old rectangular bale. To operate the round bale press only 10 HP. is required. A number of other advantages will suggest themselves to one at all familiar with the baling and shipping of cotton as ordinarily carried on, but space need not be taken to explain them here.

As already stated, the cylindrical bale method of compressing cotton is controlled by the American Cotton Co., of 27 William St., New York, N. Y., and the press is manufactured by the Walburn-Swenson Co., whose factories are at Chicago Heights, Ill. We are indebted to the company last named for the half-tone cuts used in this article, and for the information from which the description has been prepared.

SYSTEMS OF ACCOUNTS ON ENGINEERING WORKS.

By A. F. Bridgman.*

The manner of presenting the financial statements on our important public works varies almost as much as the works themselves. In one case, the expenditures are expressed in great detail, many unimportant items being given, and an opportunity offered for the criticism of small things. In another, the costs of the different parts or subdivisions of the work are given, so far as direct and obvious expenditures upon them are concerned, while other elements of their cost, such as engineering, inspection, preliminary work, etc., are charged to some general account. On one work the expenditures in detail are kept almost wholly by the engineering department, and are shown in the report of the chief engineer. On another, the accounts are kept wholly in the general office, and the engineers relieved of this burden. On still another, accounts showing the character of the expenditures are kept in the general office, while the costs of different parts of the work are compiled and presented by the engineering department. Sometimes a set of accounts is found which seems to have grown up without any design whatever except to have the total amount of money spent accounted for in some way. In spite of the varieties of expression indicated above, engineering accounting has a character of its own, and this character is best seen in the expenditure reports presented from year to year on well-known and well-managed public works.

Within the past eight years the Legislature of Massachusetts has authorized the appointment of five commissions to construct and maintain public works of great magnitude and for widely varying uses. One of these, the Massachusetts Highway Commission, is for the state as a whole; three, the Metropolitan Park Commission, the Metropolitan Sewerage Commission, and the Metropolitan Water Board are for the Metropolitan District, lying approximately within a radius of ten miles from the State House; and one, the Boston Transit Commission, is for the city of Boston. During the same period the Legislature of Illinois authorized the construction of the drainage channel for the Sanitary District of Chicago, under the direction of a board of trustees. It is interesting to notice that by no two of these boards or commissions are the financial statements presented in even approximately the same way. It will be sufficient to glance at the character and scope of three of these works, and to notice in detail the manner in which their accounts are presented. Attention will be called to certain features, but not to criticise them, for it is evident that what might be a desirable or necessary showing in the accounts of one work might be neither desirable nor of special value in another. Only round numbers will be used and many details will be omitted.

The Sanitary District of Chicago.

During the four and one-half years, from July, 1892, to December, 1896, nine-tenths of the main drainage channel from the Chicago River to Lockport, twenty-eight miles, was completed, at a total cost, exclusive of the interest and bond account, of $21,392,000.00. In the general accounts, published as part of the clerk's report, only the expenditures by departments or other grand divisions of the work are given. These are shown below:

Engineering department	$968,500
Construction	16,994,600
Clerical department	62,500
Treasury department	10,800
Law department	256,800
Land account	2,560,200
General account	313,400
Police department	164,300
Emergency fund	7,500
Pumping plants	33,000
Laborers, contract sections	18,900
Total	$21,392,000

In the report of the chief engineer, however, is given a classified statement of the cost for engineering and for construction on different portions of the works. Following are some of the principal items:

FIG. 4.—A GROUP OF CYLINDRICAL BALES OF COTTON, SHOWING METHOD OF WRAPPING AND MARKING.

Engineering.

Preliminary sundries	$120,600
Locating route, main channel	32,200
Maps and plans for general use	45,700
Chicago River survey	50,800
Construction of main channel and river diversion	473,600
Mortar, sand and cement tests	20,000
Pumping plants	35,000

*No. 3 Mt. Vernon St., Boston, Mass.

Construction.	
Main channel and river diversion	$16,314,700
Levees, trestles and embankments	202,300
Pan Handle R. R. Co.'s bridge over main channel.	35,400
Extra work, main channel	39,000
Extra work, river diversion	333,500
Saving of dimension stone	11,200
Disposal works at Lockport.	122,900

The Metropolitan Sewerage Commission.

This commission, authorized in 1889 by the Legislature of Massachusetts, to construct and maintain a system of sewerage for the Metropolitan District, has built about fifty miles of trunk sewers, four pumping stations, and other works, at a cost, September 30, 1896, of $5,950,000.

The accounts of this board are kept partly in the general office and partly by the engineering department. Those kept in the general office show the complete cost of each of the three systems named below, and also give, in considerable detail, the character of the expenditures on each of these systems, showing how much is spent for labor, how much for material of different kinds, how much for legal services, land settlements, payments on contracts, etc. The manner of presenting the expenditures by the general office is shown below:

North Metropolitan System	$4,957,000
Charles River System	789,000
Neponset Valley System	204,000
Total	$5,950,000

Details making up these amounts are shown as follows:

Office Expenses.	
Salaries—Commissioners	$52,800
Clerk and Chief Engineer	49,300
Clerical services	13,800
Cement testing	9,800
Rent of offices and care of same	18,200
Engineers' instruments	5,500
Other similar items, amounting to	30,600
Total	$180,000

North Metropolitan System.	
Salaries—Engineers, inspectors and all others, including labor	$435,200
Land taking, purchase and recording	89,900
Tools and repairs of same	16,500
Lumber and field supplies	112,000
Brick, cement and gravel	113,900
Legal and medical service	7,300
Other similar items, amounting to	54,700
Total	$829,500

Payments on contract work, and for day work not included above:

Outfall sewer, Deer Island	$112,700
Pumping station, Deer Island	171,400
Section 4, Winthrop	170,700

Followed by similar items for other sections, pumping stations, etc.

It will be seen that while the entire cost of each system is given, no attempt is made in these accounts to show the whole cost of each section, pumping station, or other division of the work. In the items shown above, the salaries of the engineering assistants, inspectors, laborers, and others, the cost of cement testing, lumber, brick, cement, and other field supplies, and the payments on account of land damages, amounting to $829,500, are simply charged to the North Metropolitan system as a whole. The cost in detail of the different sections and other divisions of the work are given, with the exception of the element of land damages, in the reports of the chief engineer. Following is an example:

Deer Island Pumping Station and Connections.	
Main building	$24,500
Coal house, coal run and screen house	15,000
Tenement house	11,000
Foundations and connections:	
Three pump wells and foundations for two engines	24,530
Connecting sewer	17,390
Grading, retaining wall and other items.	15,380
Engines, pumps and boilers	55,000
Screen machinery, heating and ventilating	2,800
Unclassified items, piping, testing of plant, etc.	10,900
Total	$176,500

Metropolitan Water Board.

The Metropolitan Board was organized in July, 1895, and since that time has laid nearly ten miles of 48-in. pipe in the Metropolitan District, is building twelve miles of aqueduct from Clinton to Southborough, is finishing a large reservoir in Southborough, and has begun work on a much larger one in the valley of the Nashua River. The total expenditures to December 1 1896, were $3,613,000. The accounts of this board are kept entirely in the general office, the engineering department being thus relieved of the details of accounting.

These accounts show disbursements in two distinct ways. First, the total expenditures of any kind, such as engineering, payments for land, contracts, etc., for the entire work, and somewhat in detail; and, second, the cost of different parts of the work in terms of these generalized accounts; one set of accounts showing what the money was spent for, and the other showing where it was spent, that is, to what works chargeable.

This method of both generalizing and distributing expenditures is fully shown in the second annual report recently issued, from which the following abstracts are taken:

Generalized Accounts (Showing Character of the Expenditures).		
Administration.		
Commissioners	$19,500	
Secretary, clerks and others	12,700	
Legal services	2,300	
Stationery and printing	1,800	
Other similar items, amounting to	6,400	
		$42,700
Engineering.		
Chief engineer and department engineers	$24,200	
Engineering assistants	122,500	
Inspectors	19,300	
Engineering instruments and supplies	15,800	
Other similar items, amounting to	37,200	
		$219,000
Real Estate.		
Conveyancer and assistants	$14,200	
Experts and appraisers	5,400	
Settlements	878,000	
Other items, amounting to	7,700	
		905,300
Construction.		
Preliminary work, including borings, test pits, etc.:		
Labor	$23,800	
Tools, machinery and appliances	12,200	
Lumber and field buildings	3,600	
Other similar items, amounting to	7,300	
		46,900
Contracts.—Nashua Aqueduct	204,500	
Sudbury department	683,900	
Distribution department	653,800	
		1,542,200
Similar accounts follow, amounting to		899,600
Total expenditures		$3,613,000

Distributed Accounts (Showing to What Works the Disbursements are Chargeable).		
Nashua Aqueduct.		
Engineering	$61,000	
Legal and expert	8,300	
Preliminary work	3,400	
Contracts, tunnel portion	56,400	
" trench portion	129,400	
" open channel portion	1,000	
" viaduct portion	17,700	
Additional work	8,900	
Real estate	12,600	
		298,700
Distribution System.		
Low service:		
Pipe lines, engineering	$42,000	
" preliminary work	8,000	
" contracts	441,300	
" additional work	11,100	
Pumping station, engineering	2,700	
Reservoir, engineering	3,000	
" preliminary work	600	
Real estate	2,500	
Legal and expert	1,600	
		512,800
Similar statements of cost for other parts of the work, reservoirs, pipe lines, etc., amounting to		2,801,500
Total expenditures		$3,613,000

It will thus be seen that the total amount disbursed, $3,613,000, is presented in two distinct ways, the first exhibit showing the character of the expenditures for the entire work, and the second the locality or parts of the work to which these expenditures are chargeable.

By the method adopted by this board, all expenditures, except those in connection with administration, are charged directly to some part of the work. The salary of the chief engineer is each month apportioned by him among the various works under his care, and every pay-roll sent in to the board for payment is thus divided. This might all be done after a fashion at the close of the year or of the work, but it is evidently a more accurate charge which is made once a month than one made after the lapse of a much longer period. Even the service of the janitor, and the lighting, heating, and other incidental expenses of the engineering department are charged off directly to the particular works which are going on at the time such expenses are incurred.

When material, such as pipe, cement, etc., is purchased and placed in a stock yard, instead of being sent to any part of the work, it is charged to a "stock account," and once a month a statement is sent in by the stock-keeper, showing to what works or sections material has been sent. These sections or works are then charged with the amount of such issue, and the stock account is credited.

Designing a System of Accounts.

In designing a set of accounts for what are called "engineering works," it should be laid down as a first principle that the compiling of costs and charging them to different parts of the work should be done in the general office, where all vouchers are kept on file, and not by the engineering department, which has responsibilities enough without being unnecessarily burdened with the details of book-keeping. More uniform results will be obtained, information will be more accessible, and greater economy will be promoted where this is done, and the periodical incursions upon the time of the engineers for furnishing cost data will be avoided. The arrangement of the distributed accounts, and the amount of subdivision desirable to show costs of different parts of the work should of course be determined from time to time by consultation with the heads of departments. By means of monthly reports from the accounting department the engineers and others may be kept informed of the cost of the works. The aim should also be to plan the accounts in such a manner as to show clearly two things, namely, the general character of all expenditures, grouped in classes and in a reasonable amount of detail, and also to show these same expenditures charged under the class name, but not in detail, directly to the works to which they belong. For example, under the class of "engineering" expenditures, it is desirable to know how much is spent for engineering service, how much for inspection, how much for instruments, etc.; but when it comes to distributing these expenditures to any particular work it is not necessary to go into these subdivisions, the general class named "engineering" being sufficient.

When a work is started, and before the sections or other divisions are blocked out, it will, of course, be necessary to charge preliminary expenditures to some general account; but just as soon as the work takes shape, and distinct parts of it are decided upon, new accounts for these parts should be opened, and proper proportions of the original general account charged to them. From this time on, every expense of whatever nature for these new sections should be charged to them, and the general account should gradually decrease. If this is not done, this "general" account becomes a kind of dumping-ground for all engineering expenses.

Among the aids to keeping accounts as outlined above are the following:

1. An "approved voucher" book, in which the cross lines are numbered consecutively from 1 to 10,000 or more. In this book are entered, as soon as ready for payment, the name, date, and the amount of all bills, pay-rolls, contract estimates or other statements of indebtedness. These bills, pay-rolls, etc., are then numbered consecutively to correspond with their entry numbers. This plan of giving to each voucher a number will afford an easy means of finding it when needed, and will be found to be of great service in many ways.

2. Journal, arranged so that each bill, pay-roll, etc., may be entered for posting both to the generalized and to the distributed accounts.

3. Two ledgers, one in which the generalized accounts are posted, and one for the distributed accounts. If accounts with individuals, firms, and others are desired, a third ledger for such use may be kept. This dividing the ledger into two or three separate books will be found convenient in many respects, but is not essential. The ordinary, double-column ledger is desirable as affording a means of transferring accounts when necessary.

4. In order to have uniformity in the charges to the many different accounts which it may be desirable to keep, a printed distributing blank, gummed at one corner, should be attached to every bill, pay-roll, etc., coming in for payment; the names of accounts most in use to be printed in fine type, and blank lines left for additional accounts as they may be needed. On this blank should be indicated, by the one who certifies to the correctness of the voucher, the amounts to be charged to different accounts. This blank will also serve as a backer for the bills, showing, when folded, the name, date, amount, and number.

Public accounts might be kept in less detail than is outlined above, but any public work is liable to investigation, and it is desirable that the statement of all expenditures and receipts be perfectly clear, and that the corresponding vouchers and certificates be easily accessible.

It may be said that there is considerable machinery in connection with these methods, but may it not also be said that it is good machinery?

A NEW PARCELS EXPRESS SERVICE FOR NEW YORK CITY.

In its issue of May 14, 1896, Engineering News called attention editorially to the possibilities of improvement in the transportation of goods in towns and cities, and outlined briefly what it conceived to be an efficient method of accomplishing such an improvement. At that time, although unknown to the editor of this journal, Mr. L. C. Wier, President of the Adams Express Co., and his associates were at work upon a comprehensive system of parcels delivery for New York city, which has since been put into operation. This system of express service, organized by the Adams Express Co., agrees so closely with the system outlined in Engineering News, and its success in operation has proven so conclusively the accuracy of the prophecy of success made by this journal, that a brief description of some of its salient features is given here, with the hope that other cities may profit by the information. For a more general discussion of the whole question of urban express service the reader is referred to the editorial noted above.

For the purpose of carrying on a local express service in New York city, the Adams Express Co. organized the Manhattan Delivery Co., with Mr.

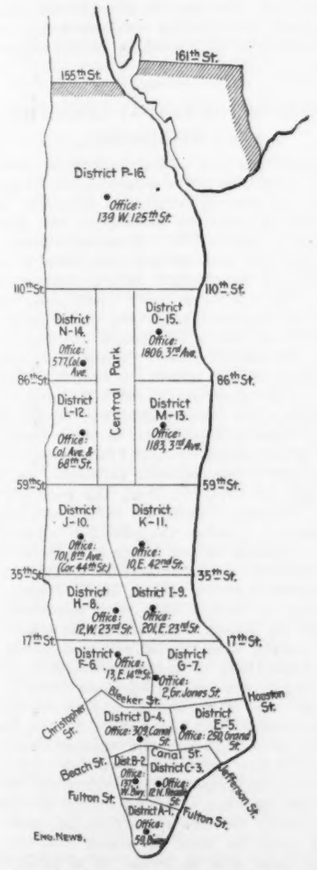

Fig. 1.—Sketch Map of New York City Showing Express Districts of the Manhattan Delivery Co.'s Parcels Express Service.

James Eggleston as President. It was appreciated that to make such a service popular, regularity and certainty of delivery and collection were first of all necessary, and this fact was kept the controlling factor in the entire work of organizing the service. The city was first divided into 16 "districts," arranged as shown by the accompanying sketch map, Fig. 1; District A-1 beginning at the Battery, and District P-16 terminating at 155th St. In each district was located an office and depot, as shown by Fig. 1, for receiving and delivering goods, and each office was placed in charge of an agent.

The service itself consists of a regular schedule of large two-horse vans running between the district stations, and receiving and delivering goods at these stations only, and of from three to nine one-horse delivery wagons in each district which collect and deliver the goods for that district alone. A large van starts from station A-1 and from station P-16, every hour, and arrives at each intermediate district station on schedule time. At each station the district wagons meet the large van and deliver to it such parcels as they have collected which are bound for the districts to which it is going, and at the same time receive from it such parcels as are destined for delivery in their district. Each district station thus receives and delivers a cargo of parcels every 30 minutes, from 8 o'clock in the morning until as late at night as the conditions of traffic may call for.

It will be understood, of course, that the schedule as described above is the one now in force, and that the frequency of delivery and collection can easily be increased as the traffic grows to demand it. Express vans between widely separated districts of the city are also possible and, in fact, are already contemplated by the Manhattan Delivery Co., and indeed almost any elaboration of the schedule is easy whenever the business shall make it desirable. In order that an idea may be had of the appearance of the large vans of the Manhattan Delivery Co., we show in Fig. 2 a drawing from a photograph which shows the van loaded and manned with its regular equipment of driver and conductor. It will be noticed that the van is provided with side instead of end doors, and can be securely closed against theft or loss during its journey from one station to another.

The rates charged by the Manhattan Delivery Co. are flat rates for all parts of the city, but vary with the weight of the parcel. For parcels weighing 20 lbs. or less the rate is 15 cts.; for parcels of from 20 lbs. to 50 lbs. weight it is 20 cts.; and for parcels weighing from 50 lbs. to 100 lbs. it is 25 cts. In other words, it costs 15 cts. for a parcel weighing 20 lbs. or under, whether it is carried only a dozen blocks, or from the Battery to 125th St., a distance of eight miles. The time taken to deliver a parcel depends, of course, upon the distance to which it is carried, but, starting from the Battery in one of the large vans it will reach 125th St. in about three hours, and, owing to the fact that all wagons are run on schedule time, delivery on time at any part of the city is practically made certain.

In regard to the character of traffic which the service has developed, Mr. James Eggleston, President of the Manhattan Delivery Co., informs us that it is pretty general. Somewhat to his surprise he found that the system was extensively patronized by the wholesale houses in the lower part of the city to deliver goods to the retail stores. The larger retail stores having their own delivery wagons, used the company's wagons only infrequently, but householders and small shopkeepers made considerable use of them. From its very start the traffic has grown every week as people come to know of the service and to understand its reliability.

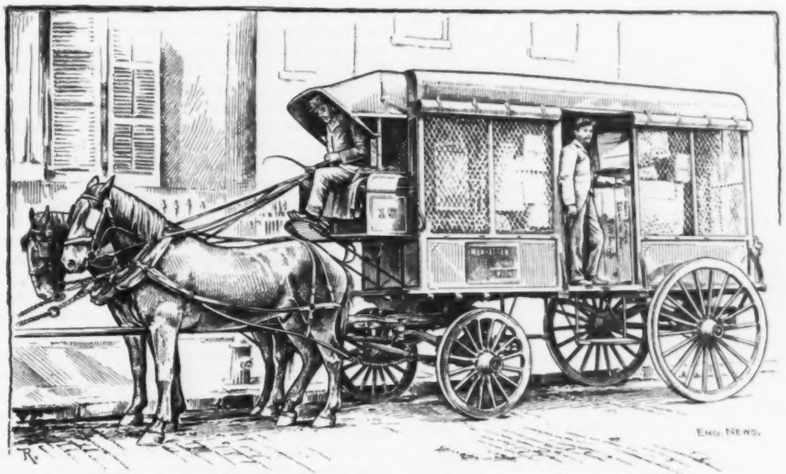

FIG. 2. LARGE DELIVERY VAN USED IN THE MANHATTAN DELIVERY CO.'S PARCELS EXPRESS SERVICE IN NEW YORK CITY.

WEIGHT PER CUBIC FOOT OF VARIOUS COALS.

The Bulletin of the Anthracite Coal Operators' Association for November quotes from the "Black Diamond," a coal trade journal published in Chicago, the following table of weights of various coals:

	Weight per cu. ft., lbs.	Cu. ft. per ton 2,000 lbs.
Lehigh lump	55.26	36.19
Lehigh cupola	55.52	36.02
Lehigh broken	56.85	35.18
Lehigh egg	57.74	34.63
Lehigh stove	58.15	34.39
Lehigh nut	58.26	34.32
Lehigh pea	53.18	37.60
Lehigh buckwheat	54.04	37.01
Lehigh dust	57.25	34.93
Free burning egg	56.07	35.67
Free burning stove	56.33	35.50
Free burning nut	56.88	35.16
Pittsburg	46.48	43.03
Illinois	47.22	42.35
Connellsville coke	26.30	76.04
Hocking	49.30	40.56
Indiana block	43.85	45.61
Erie	48.07	41.61
Ohio cannel	49.18	40.66

THE GLASGOW, SCOTLAND, STREET RAILWAYS are owned and operated by the city, and the net profit reported for last year was $416,335, after all interest charges on the investment and plant had been met. Three years ago the tramway companies leasing the lines, which were built and owned by the city, refused to renew the leases on terms satisfactory to the municipal authorities. The corporation then decided to operate them as part of the public service, and offered to purchase cars, stables and horses at a reasonable price; provided, the company would not attempt to compete by organizing omnibus lines. This guarantee was refused and the corporation provided a new equipment and organized its own force with the above result. Meanwhile, under efficient management, fares have been reduced, workmen's half-penny hours have been ordered, the operatives' hours have been shortened and their wages raised and the lines have been extended in many directions. The same policy is said to be succeeding in other English towns. Leeds purchased the property of the tramway companies for $650,000, mainly for redressing the grievances of the operatives who worked 14 hours per day; the annual net profit to Leeds is now $59,170. Huddersfield, though it has made unprofitable extensions and reduced fares, has a profit of $31,495 as the result of the first year's working. Sheffield, Blackpool, and Plymouth have similar experiences. Liverpool and Manchester build their own tramway lines, and pay interest on the original investment and keep the track in repairs for about 3%, and lease them for 10% of the cost of construction to operating companies. But these corporations are very conservative in the control, and horses are generally used upon the lines. Electric traction receives little encouragement from them, even for lines with steep gradients. Glasgow, however, is to change its system to electric traction and a contract for the work has been given to the Westinghouse Electric Co.

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In his interesting description of a notable new bridge at Berne, Switzerland, in this issue, Mr. E. L. Corthell calls attention to the opportunities for American bridge builders to secure contracts in Europe at remunerative prices. Evidence that some, at least, of our bridge building firms are already at work in this field is furnished by the recent bids for the bridge over the Yssel River in Holland. As reported in our "Industrial Notes" department last week, the Pencoyd Bridge Co. was the lowest bidder for this important work. The contract has been finally awarded to a Dutch firm whose bid was $13,000 higher than that of the Pencoyd company; but the incident is none the less to be regarded as an important victory for American engineering, and a new demonstration of the ability of American manufacturers to underbid their rivals in international competition.

We have frequently pointed out that in considering projects for water-power development at the present time, the most important question to determine is the prospect for marketing the power after it is developed. It matters not how unfailing the flow, or how enormous the power that may be developed at a given place; if no market can be obtained for it, those who invest their money in the enterprise will inevitably be disappointed.

In another column of this issue we give the latest particulars as to the progress upon a large water-power development plant at Massena, N. Y., where water is to be taken by an open canal from a point on the St. Lawrence river above the Long Sault rapids, and led to the banks of a tributary which joins the river below the rapids. The canal is being dug, we understand, to furnish no less than 150,000 HP. and machinery to develop one-half this amount is said to be already contracted for. It nowhere appears, however, what the company proposes to do with this power when it is developed. We venture to say that most of our readers will have to consult a map to find the location of Massena. After some search they will find it in St. Lawrence county, on the northern border of the Adirondack wilderness. To use a forceful expression, it is a mighty long ways from anywhere. The county in which it is located is nearly a half larger than the State of Rhode Island, but its population is less than 30 to the square mile. If we describe a circle about Massena with a radius of a hundred miles, it will be found that only a very few cities are comprised within the area, and they all have water-powers capable of supplying all their needs much nearer them than the Massena power. We see no prospect, therefore, that the Massena company can dispose of its power by transmitting it to cities for electric light and power purposes.

It may be that the company expects to build up a manufacturing center about its plant, through the advantages of cheap power; but here again it seems likely to meet disappointment. With the exception of a few special lines of manufacture the matter of cheap transportation is of far more importance to a manufacturer than cheap power, and Massena is far removed from centers of population and markets. As for the manufacturers who use large amounts of power, already they are being bid for by other water power plants much more convenient to markets than that at Massena.

Perhaps those who are building the Massena plant are looking far enough into the future to foresee the operation of steam railways by electric power, and are planning to furnish current to the railways in their vicinity. If this is the case, we can only say that he must be a bold man who will invest money in an enterprise which looks so far into the future and which depends for success on so many matters which at the present are, to say the least, extremely uncertain.

It is stated that the capital for the Massena enterprise is being chiefly furnished by Englishmen, and we will leave them to answer the question as to what they will do with their power when they get it.

A long and bitter struggle over the ownership by the city of Duluth of the works which supply the city with gas and with water appears to have been terminated at last by an agreement for the purchase by the city of the combined water and light plants of the Duluth Gas & Water Co. for $1,250,000. Some of the details of the conflict are given elsewhere in this issue in a letter to this journal from Mr. Henry Truelsen, Mayor of Duluth. Mr. Truelsen has been largely instrumental in reducing the price to be paid for the property from $2,106,000, which the people actually voted to pay in 1894, to $1,250,000. He has accomplished this by the aid of the courts and by creating and leading public opinion. Different city engineers estimated the actual value of the company's plant at about $1,000,000 and Mr. Truelsen's aim was to bring the price as nearly as possible to that figure. Not long ago the city decided to build water-works. It started by beginning the construction of a so-called supplementary system, duplicating parts of the old works, believed by the city officials to be useful in a system properly designed for the needs of the city and expecting to utilize the old distributing mains, if finally bought from the company. Doubtless the fact that the city began to build works contributed largely to the reductions in price made from time to time by the company, but it is not likely that this is the only explanation. The struggle is but one of many recent examples of the strong tendency towards municipal ownership of such undertakings. Scores of cities have changed from public to private ownership in the past ten years, many of them only after bitter fights, as witness Kansas City, Syracuse, Auburn, Me., etc. The struggle at Duluth has differed materially from the others in that both the company and city have seemed to agree readily enough as to price, but some citizens in either their private or public capacity have maintained that the price was excessive, and have upset the whole bargain by proving that the bond elections were invalid. Each defeat has been followed by a concession in price until finally the company has come down pretty nearly to the estimates made by engineers employed by the city.

From some examples that have recently been brought to our notice, we think a word may not be amiss as to the need of greater care by manufacturers concerning the statements made in their published catalogues. It is not at all uncommon to find in such catalogues inaccurate and extravagant claims: and when, as occasionally happens, manufacturers are asked to make contracts on the basis of such claims, it is decidedly unpleasant to have to refuse. In a case in point, the builders of a certain machine claimed in their catalogue that it would "do its work without repairs or shut-down even when in charge of the most inexperienced hands and under the most trying conditions." An intending purchaser of such a machine desired the manufacturers to make a guarantee to this effect; but they refused. Even a proposal to use the term "when given ordinary attention" instead of "when in charge of the most inexperienced hands" was refused by the manufacturers. Naturally the purchaser formed an opinion adverse to the machine and purchased from another manufacturer a machine which is in all probability no better than the one which he investigated first. The sole reason for this is that the manufacturer refused to guarantee that his machine would do what he had declared in his catalogue it would do. In all probability the statement was prepared by an advertising manager who was entrusted with the preparation of the catalogue, and who thought mainly of making a nice looking book with well turned phrases, without much regard to the actual meaning of these phrases. This, however, is not the right way to prepare the information for a catalogue, though it is one that is followed more or less. Where catalogue matter is written by a subordinate, or an advertising specialist, it should be examined and corrected by a responsible member of the firm. No concern can afford to send out catalogues or published advertisements containing statements by which it is not prepared to stand.

PROSPECTS FOR RAILWAY LEGISLATION AT WASHINGTON.

The indications are that railway questions are likely to receive more attention at Washington during the present session of Congress than at any session since the passage of the Interstate Commerce Law of 1887. It seems almost certain now that one and perhaps two bills to legalize pooling will be brought before Congress during the winter, and it is quite likely, too, that the advocates of a law prohibiting ticket scalping will endeavor to secure legislation on that question before the session closes. While these questions are occupying the legislative branch of the Government, the Supreme Court will have before it for decision the case of the Joint Traffic Association, in which a second test is being made of the power of the Sherman Anti-Trust Law to prevent traffic agreements between railways. A decision may also be expected from the Supreme Court in the Nebraska maximum rates case, involving the question whether the power of state authorities to regulate railway rates is limited. The recent decision of the Interstate Commerce Commission (Eng. News, Dec. 9, 1897), respecting the equipment of freight cars with automatic couplers and air brakes, may also be included as part of the present season's railway legislation.

The importance of these questions to the railways and to the general business public is plain. They are also of particular interest to engineers, for the reason that the nature of the decisions rendered will influence the expenditures of the railways in new extensions, renewals of track and equipment, and improvements generally. The ability of the railways to spend money for improvements clearly depends upon their success in maintaining rates at least as stable and as profitable as those now in force. It is generally admitted that this cannot be done if the railways are denied power either to pool or to combine in traffic agreements. Sooner or later, it is contended, unless some such agreement is in force, competing railways are sure to quarrel in the future as they have always done in the past, and a general rate war will follow which will destroy what little chance the railways now have of pulling out of the depression in which the last few years of hard times have left them, and of making the extensions and renewals which their property is admittedly in need of. No one who has studied railway questions has much doubt that this result is a very probable one. We need not, therefore, apologize for bringing before our engi-

neer readers questions which seem at first to be outside of their immediate field of interest.

The question of pooling and the question of traffic agreements are so nearly alike that it is almost necessary to consider the suit against the Joint Traffic Association and the proposed pooling bills in the same connection. The Joint Traffic case, which the Supreme Court now has before it for decision, resembles very closely the well-known case against the Trans-Missouri Freight Association, upon which this same court handed down its decision in March of this year. The point decided in this first case, as we explained at the time, was that the Sherman anti-trust law, making criminal all contracts "in restraint of trade," applied to interstate contracts between railways designed to prevent fluctuations in rates. This was held to be the case, even granting that such contracts were perfectly reasonable in themselves and even of advantage to the public.

Since the Joint Traffic Association was organized for practically the same purpose as the Trans-Missouri Freight Association, it would seem to the layman that the sentence had been determined by the decision in the older case. Many lawyers of prominence, however, have expressed the hope that the former decision may be reversed. As nearly as we can get at the matter, this hope seems to be based upon the belief that the Trans-Missouri decision is so far-reaching in its effects, and delegates such comprehensive and arbitrary power to Congress, that it makes the law itself unconstitutional. It will not aid our purpose to discuss this point here, and it is idle to attempt to predict the action which will be taken by the Supreme Court, but the reader cannot fail to observe that this action is intimately connected with the chances which any pooling bill has of passing Congress.

The Interstate Commerce Act now prohibits pooling. Should the Supreme Court uphold its former decision, when it passes upon the Joint Traffic case, the railways will be prevented from entering into legal traffic agreements of any kind. Since some agreement of this nature seems necessary to prevent rate cutting, with all its attendant evils to railways and to business, it seems clear that the railways must seek their salvation in promoting a bill to legalize pooling. The railways seem to realize this and will doubtless exert themselves to secure the necessary legislation, but they also show a disposition to quibble over details, which certainly does not seem justifiable considering the vital importance to them of the permission to pool. In order clearly to understand the position of the railways in this regard it is necessary to review briefly the nature of the legislation which is offered to them in the pooling bills which are likely to be brought up at the present session of Congress.

All the bills to legalize pooling which have yet been introduced into Congress provide that the final legality of every pooling agreement must be dependent upon the approval of the Interstate Commerce Commission. The Commission itself has always strongly insisted upon this regulating power. The opinions of the lawmakers as to how the power shall be exercised, however, differ. In the Patterson bill, first proposed in 1894, the approval of the Commission is necessary before a pooling contract can go into effect; but in the Foraker bill, introduced at the last session of Congress, it is provided that pooling contracts can be made without the approval of the Commission, but the right is reserved to the Commission to object to the contract after actual experience has demonstrated its results. In neither bill is the power given to the Commission to make rates, except in so far as the disapproval of a particular rate on the ground of its being excessive involves the necessity of the railways making a rate which will meet the views of the Commission. The real difference between the Patterson and the Foraker bills is that the former requires the expressed approval of the Commission before a pooling contract can go into effect, while the latter requires the expressed disapproval of the Commission to prevent a pooling contract which has been made from being continued.

There are, of course, minor points of difference, as well as resemblance, between these two proposed bills, but they may be neglected for the present. The chief point which we need to notice further is the power given to the Interstate Commerce Commission with respect to making rates. If we may judge from the interviews now being published in the daily papers, the impression has got abroad that these pooling bills give the Commission power to make rates, and that the railways have a just cause of opposition for this reason. But so far as we can find, this impression is a groundless one. The Commission has never asked for any rate-making power beyond what is absolutely necessary to make effectual its action annulling excessive rates, and it seems eminently reasonable that it should have this privilege. A few words will, we think, make this clear.

It has been frequently pointed out by lawyers that pooling contracts are in contravention to the common law. It is well known that they are specifically prohibited by numerous State laws as well as by the Interstate Commerce Act. It seems no more than proper than, that in granting the privilege to pool Congress should provide safeguards against its abuse. It must not be forgotten that it was the frequency of such abuses in the past that led to the specific legislation of the Interstate Commerce Act prohibiting pooling contracts. The question, then, whether the rates established by the pooling contract are such as carry injustice or discrimination toward the great body of shippers is properly one for the Commission to pass upon, and this is all the power that either of the proposed pooling bills confers upon that body with respect to rate-making.

The railways, it is quite likely, would prefer to have the privilege to enter into pooling agreements unfettered by any regulating power of the Interstate Commerce Commission, and will perhaps make an attempt to secure their end when the question of pooling comes before Congress. We cannot conceive, however, that they will insist upon this point to the extent of jeopardizing their chances of being allowed to pool at all. While the attitude of the best-posted men is doubtless on the whole favorable toward pooling, probably few students of railway matters would to-day favor for a moment a return to the pools in vogue previous to the passage of the Interstate Commerce Act in 1887. If we are not much mistaken, the shippers will also strongly oppose such action.

The question of legalized pooling is, as we have said, but one of the subjects for railway legislation which Congress may be called upon to decide. As many of our readers will remember, a bill to make ticket scalping illegal was held over from the last session of Congress, and will doubtless be brought up for early consideration. It seems almost unnecessary to point out the desirability of some law to restrict this traffic, but if we may judge from the past, only an apathetic support will be given to it by the railways, although they will be the chief ones to benefit by such a law in the long run. Fortunately the public also has a direct interest in preventing the practice from being continued. Laying the morals of the business, which as everyone knows are exceedingly shady, entirely aside, there is no economic excuse for the ticket broker, or "scalper" as he is more often called. It must be evident upon the slightest thought that these persons live by the margin between the prices at which they buy and at which they sell unused tickets. The Interstate Commerce Commission is authority for the statement that this profit amounts on the average to $1,000,000 each year. Now this profit must come either from the railways or from the public, and neither is bound by any service which the scalper renders to surrender it to him.

From the point of public morals alone, however, the traffic ought to be prohibited. A very slight acquaintance with scalpers' methods is enough to show that a great portion of their business is fraud and criminality, the buying of passes and mileage books issued to persons for special considerations, the corruption of railway employees, the forging of dates and names, and various forms of petty fraud. The State of New York has already stamped the traffic as punishable, and Congress will perform a righteous action in following this precedent.

The Nebraska maximum rates case is chiefly important because its decision by the Supreme Court will determine the power of railways to obtain redress from unreasonable state laws. The case is very briefly as follows: In 1893 the state of Nebraska passed a law establishing maximum freight rates to be charged by the railways of that state. This rate made a reduction of about 29½ per cent. in the local freight rates then in force, and the railways appealed to the United States courts to relieve them from obeying the law. The contentions of the plaintiff and defendant and the decision of the Court upon them, are made clear from the following excerpts from the opinion of Justice Brewer, of the U. S. Circuit Court, rendered in December, 1894:

There is no sufficient remedy at law to deprive a United States court of equity of jurisdiction over an alleged unlawful reduction by a State statute of freight rates, by reason of the fact that the statute provides for a petition to the State court which may, in its discretion, direct the board of transportation to permit the carrier to raise its rates to the former amount.

A State legislature cannot deprive a United States equity court of jurisdiction over an alleged unlawful reduction of freight rates affecting citizens of other States by itself prescribing them by direct act, instead of delegating the authority to a commission.

The amount invested in a railroad cannot be ignored in determinnig the reasonableness of rates fixed by law to be charged thereon, although such amount is far in excess of present value of the property.

There is no hard and fast test which can be laid down to determine whether or not the rates of railroad freight charges established by the legislature are just and reasonable.

A reduction of 29½% by the legislature in the local freight rates of the railroad is unreasonable and void, where the new rates would result in a loss on local business to more than half of the roads affected by it, and as to the other roads the earnings from local business would not be enough to pay the proportion of the interest on the bonded debt which should be paid by such business in comparison with business of other kinds.

The fact that the freight rates are higher in one State than in another is not of itself sufficient to justify an arbitrary reduction of them by the legislature in the former State for the purpose of equalizing rates.

The enforcement of an unreasonable reduction by the legislature of freight rates may be enjoined.

The decision of Justice Brewer was in favor of the plaintiffs, and the State took appeal to the United States Supreme Court, which now has the case under consideration. Should the lower court decision be upheld, it is clear that many of the difficulties between the railways and the people, which have for several years made a number of our Western States notorious for their severity toward railway corporations, and which have almost stopped railway construction within their borders, will in the future be greatly lessened.

In closing this brief review of the railway legislation, which is likely to occupy attention during the next few months, it will be profitable to repeat what we have often said concerning the attempts of the lawmakers to secure unrestricted competiton in railway transportation. We may pass laws punishing a railway corporation for agreeing not to compete, but we cannot legislate so as to make it compete against its will. If the railways decide not to underbid each other for competitive business, nothing can prevent them. Practically there are reasons why such tacit agreements cannot be very long standing, but consolidation is always possible, and if the legislators persist in passing laws to restrict combination, the railways of the country, in order to save their property, will ultimately be compelled to consolidate into a few great systems situated geographically so as not to compete with each other.

If Congress desires to end permanently railway competition in this way, it can take no surer course than to continue its prohibition of the pool and the traffic association, the only artifices by which competing railways are enabled permanently to continue their independent existence.

LETTERS TO THE EDITOR.

A Comparison of the Leakage of Two Conduit Electric Railway Systems.

Sir: In your issue of Nov. 25 appears a note concerning the operation of the trolley conduit used on the Metropolitan Street Railway Co.'s lines in Washington, D. C., when flooded for a distance of 150 ft. With your kind permission, I would like to compare the results alluded to with results published elsewhere. The Metropolitan conduit is some 25 ins. deep, with a maximum width of some 18 ins. inside. The air chamber conduit described in the "Electrical Engineer" July 22, 1897, and Engineering News Oct. 20, 1892, and Aug. 12, 1897, is but some 7×6 ins. outside. When 50 yds. of the Metropolitan conduit was flooded the power had to be doubled in order to get the cars through one by one. This means a loss of far

over 50%, or many horse power. When 175 yds. of the air chamber conduit was flooded and a car running back and forth over this section the loss was slightly over 1 ampere at a pressure of 500 volts, or slightly over ⅝ HP. ("Elec. Eng.," July 22, 1897). But the air chamber has shown better results—a loss of but ⅛-HP. on 175 yds. ("Elek. Anz.," Berlin, Nov. 12, 1896). Again, it does not appear that the cars were or could be stopped and started by the Metropolitan road in that flooded 50 yds., while the cars were stopped and started at will in the flooded 175 yds. of the air chamber conduit. Verbum Sap.

New York, Dec. 9, 1897.

Steel Rail Contracts and Manufacture in Australia.

Sir: By the "Frisco" mail that left here on Sept. 29 you were informed that the government of New South Wales had accepted an offer from an American house to supply 2,000 tons of steel rails. It has since transpired that the price is £5 per ton delivered in Sydney. There has been a desire to procure rails of higher carbon steel than have been used in the past, on the plea that they are stronger and are more durable and that such rails could not be procured from England. The indent was placed with an American firm of iron manufacturers, with the result as above stated. The usual practice of calling for Public Tenders, or "Bids," as you call it, was not adopted in this instance, and probably some explanation may be called for when the legislature meets next week. It will be within your recollection that some months ago bids were invited in the United States to establish works in this colony to manufacture 150,000 tons of steel rails within five years from material found in the colony. The conditions contained some very stringent clauses, and as a result only one tender, and that a local one, was secured. The firm in question, Hoskins Brothers, are large and enterprising manufacturers of iron work, especially water mains, the iron being imported. Their tender for the supply of 150,000 tons of rails was not accepted, being considered too high, but during the past week the government have conditionally accepted the tender of Mr. Joseph Mitchel that the necessary security be forthcoming. On that score no difficulty is apprehended, as Mr. Mitchel has already made his arrangements with English capitalists.

The terms are that the government is to pay £6 per ton for steel rails delivered into railway trucks at the company's works, with the proviso that, if the market price of steel rails rises during the currency of the contract, then the New South Wales government is to pay £6 5s. per ton, and if the price falls, then the government is to pay £5 15s. per ton. The government is also to give Mr. Mitchel's company the privilege of manufacturing all the iron work required by the government during the currency of the contract on terms to be arranged. Yours very truly,

John Musson, C. E.

Sydney, N. S. W., Oct. 4, 1897.

A Matter of Engineering Ethics.

Sir: If you do not consider the subject of engineering ethics to be worn threadbare, I would like to contribute the mite of an early experience of mine. Twenty years ago I stood at the threshold of the profession, equipped with the degree of B. C. E. and the personal acquaintance of one practising engineer. I went to this man for advice and also for any help which he could give in obtaining a professional engagement. He advised me to subscribe for Engineering News, which I did, with much resulting benefit; he also gave me letters to two friends of his, both as well as himself prominent members, and at a later date officers of the Am. Soc. C. E., on whom I waited the next day and at intervals for several months thereafter. The gist of the information acquired at these calls was the date or dates when I might call again, and I soon discovered that I was merely being "passed along" and that the favor was probably repeated and reciprocated as occasion required. All feelings of personal disappointment have long since passed away and the animosity, indifference or friendship of these men is now a matter of no sort of concern to me. I would not thrust this, a purely personal matter, before your readers except to illustrate by one concrete example an entire absence of any sense of fraternal feeling which must exist to some extent even between the highest senior and humblest junior in an occupation which aspires to the plane of a profession.

I did not care to be an object of care and solicitude, nor to be provided with work which did not exist, but I considered then, and do still, that any man of earnest purpose who has spent the necessary time and money required for a college preparation is entitled to something more than the contemptuous indifference which I received at the hands of these professional brethren(?).

While this sentiment continues to exist to any appreciable extent among prominent members of the profession and give character to it, much of the foundation timber on which to build a platform of engineering ethics or anything like it has yet to grow. Engineering Ethics.

Nov. 10, 1897.

(We think it likely that our correspondent was unfortunate in the personality of the engineers through whom he sought employment. It is, or ought to be, the rare exception when an engineer in search of employment is treated with "contemptuous indifference" by his more fortunate brother. It must be remembered that the demands on the time of a busy engineer, in a position of responsibility, are very great, and if such a man cannot himself give employment to an applicant, he can in general do nothing more for him than to give him a word of sympathy and wish him good fortune in his search for a position.—Ed.)

The Tropenas Process of Steel Making.

Sir: You have been kind enough to publish our letter of Oct. 5 in your issue of Nov. 4, with an interesting editorial note, supplemented by some comments of Dr. Henry M. Howe on the Robert process. We know the latter process, having had it in operation in our works for nearly 12 months, and our experience was so unsatisfactory that we abandoned it. Dr. Howe's opinions may be perfectly correct about it, but they do not apply to the Tropenas system. Theory and theorizing are very proper in their place, but they need the chastening and guiding hand of intelligent experience.

If we get from a process results which are highly successful, both mechanically and commercially, what would you think if we gave it up and quarrelled with the inventor because his theories about it did not commend themselves either to us or to somebody else? Apparently, steel manufacturers in the States dare not take up the Tropenas process because somebody (who has not had experience of it) says the theory is wrong; or, rather, because somebody says the theories of the inventor of quite a different process are wrong. We have heard, in fact, that "expert opinion" in the States has asserted that Tropenas steel cannot be good "because it is made in a Bessemer converter." If such an opinion has really been expressed we can only express our astonishment at the total misapprehension of the nature of the Tropenas process and its results. Anyhow, the opinion is not very complementary to the Bessemer process.

Edgar Allen & Co., Ltd.
R. Woodward, Managing Director.

Imperial Steel Works, Sheffield, England,
Nov. 24, 1897.

(We freely admit that the use of the Tropenas process by such a firm as that named above, and by the numerous firms which have adopted it in Belgium, France, Russia and other countries, together with the excellent material which we are authentically informed is produced by the process, is all good evidence that it must have merit. Yet the chief distinguishing feature of the process, so far as we can learn, is the use of two sets of tuyeres, one of which is about 4 ins. above the other set, and is used only for a short time at a certain stage of the process. It still seems to us quite inexplicable that so slight a detail as this can influence the character of the product so largely as is claimed by those interested in the Tropenas process. The only reason we find given in favor of the two sets of tuyeres is that the upper set gives an additional supply of air, and burns the carbonic monoxide to dioxide, thereby giving a high degree of heat in the converter. It is urged that this high heat gives a metal so hot in the ladle that very small castings can be poured. Also that from some cause or other the metal is very quiet in the ladle, and sound castings are made without the use of large sinkheads. This explanation runs counter to some generally accepted ideas regarding steel manufacture. However, the results obtained by manufacturers using the process seem to be so excellent and so well attested that it seems well worth investigation by American steel founders and metallurgists.—Ed.)

Proposed Storage Reservoir and Infiltration Conduit for the Water Supply of Columbus, O.

Sir: In your issue of Nov. 25 you published a communication from me with answer thereto by Mr. Julian Griggs, City Engineer of Columbus. In view of the statement that Mr. Griggs makes, I would like to answer his letter. Instead of defending his plans, Mr. Griggs attacks my statements that the water is 2½ times harder after having passed through the bed of gravel into the conduit than it was when it entered from the river. As Mr. Griggs attacks this point, I will defend it. The analysis of water taken from the hydrant by Mr. Curtis C. Howard (see p. 98, 10th ann. rep. State Board of Health of Ohio), as compared with the analysis of the river at an average stage of the water by Mr. R. M. Hughes, assistant to Prof. N. W. Lord, is as follows, in parts per 100,000:

	Hydrant water.	River water.
Total solids	62.9	39.5
Fixed residue	51.6	26.
Loss on ignition	11.3	13.5
Temporary hardness	36.9	19.5
Permanent hardness	13.7	7.8

These analyses show the hydrant water to contain two and one-third (one and two-thirds.—Ed.) total solids contained in river water, and about twice the temporary hardness. I am aware that we have taken the extreme in case of the analysis of the hydrant water, for the reason that Mr. Howard took his analysis at his home. But it is true that the bulk of the hydrant water now furnished from underground sources is a great deal harder than the river water, and that passing through a gravel bank, such as we have, never diminishes total solids but always increases them.

At the present time, the water passes through from 30 to 300 ft., and possibly 3,000 ft. of gravel strata to reach the conduit. The new conduit contemplated under the river bed can be reached by river water at a distance of 15 ft. from the bed of the river, which will strain filth from water until the gravel bed itself is thoroughly saturated with the organic and inorganic filth of the river. It being impossible to clean this natural filter, and the typhoid fever death rate of the city obtained from the old natural filter reaching the enormous figure of 3.86% of the total deaths, the question naturally arises, to what point will our typhoid fever death rate go?

As to the surveys for the 60-ft. dam which my plans contemplate, we have made all of the preliminary surveys, including that of the canal, and these surveys show the ridge spoken of by Mr. Griggs as being 150 ft. to be 220 ft. above city datum, or, 120 ft. above the State House terrace. As this gives a static head greater than that now used by the city water-works, it certainly will be ample for the city supply.

I did ask Mr. Griggs for the records of his topographical survey, because they were public records and not private documents. I obtained topographical maps and all detailed plans of the water supply of New York city, but failed to get corresponding documents in Columbus. I have always assumed that the public records made at the expense of the people were public property. I may be mistaken in this. In justice to the proposed organization of the private company for the purpose of offering to the city water upon our proposed plan, I believe this is a true solution to the Columbus water supply. The private company can offer the city water cheaper than they can get it of their own accord, for the reason that water power, park privileges, and other sources of income to the private company would be such that they could well afford to deliver the water to the city at a much smaller figure than the city can possibly obtain their own supply; unless they should enter the domain of private ownership and sell the excess of power to private consumers, build electric railroads and operate them in connection with a park, as proposed by private ownership. Yours truly,

Columbus, O., Nov. 30, 1897. John J. Dun.

The Struggle Over Municipal Ownership of the Gas and Water Plants at Duluth, Minn.

Sir: In answer to yours of Nov. 30, I will say that after years of litigation we have at last agreed with the holders of the bonds of the Duluth Gas & Water Co. to purchase its water and light plant for $1,250,000, the city assuming $295,000 first mortgage 6% bonds, issued by the company, running for about nine years longer, the balance to be paid in cash. The proposition will be voted on by the people on Jan. 12, 1898. There is not the slightest doubt but that the proposition will carry by a large majority. As soon after election as may be we shall offer bonds, perhaps at 4½%, on which we expect to receive a handsome premium. The net earnings for the gas and water plant for last year amounted to $115,000, and will greatly increase when the plant becomes the property of the city, because our so-called supplementary system, which will be completed by Feb. 1, 1898, covers about eight miles of territory not now covered by the old plant. Our new system, when completed, will cost $750,000; add to that amount the price we are to pay for the old plant and we have a total of $2,000,000. The net earnings of the old plant, $115,000, would not only pay the interest on the whole bonded indebtedness but would leave a surplus in the treasury if the revenue did not increase, but we have good reason to believe that our revenue will increase 25%.

This is a happy solution of a long and desperately fought struggle, dating back almost ten years. I am glad to state that in about 90 days from date, when we will be able to connect our own supplementary with the present system, the people of Duluth will be furnished with the purest water in the world.

I shall now briefly refer to the past history of the water struggle. As above stated, it dates back ten years. Several elections were held prior to October, 1894, but at that time the people voted to purchase the gas and water plant at $2,106,000. Knowing that this price was about double the actual value of the plant, I deemed it my duty, although a private citizen, to contest the election. Although defeated three times in the District Court, I finally succeeded in the Supreme Court of the State and the election was declared null and void on account of the complicated nature of the ballot. The next election following this was on a proposition for $1,850,000 for the water plant alone, which we defeated. The next election was for $1,856,000 for the gas and water plant, or to issue $1,856,000 to build a water plant. We carried the proposition to build by a large majority (and the result is a supplementary system bring-

ing pure water into the city from a point eight miles up the north shore of Lake Superior). The next election was ordered over my veto last fall, the vote being on the issue of bonds to the amount of $1,695,000. The proposition was declared carried. I again contested the election, in the name of a close friend, on the ground that votes had been counted wherein voters had voted "yea" on the proposition to build and "yea" on that to buy also. I won in the District and Supreme Court, and a recount showed that the proposition was defeated by about 1,600 votes. Early this fall negotiations were again taken up, and an offer was made to sell the water and light plant to the city for $1,450,000, which we refused. This time the council stood by me. Since then I received an invitation to meet the representative of the English bondholders at Chicago, which I did. I made them an offer of $1,200,000 for the combined plant. They refused it and we parted. Since then, negotiations were taken up with E. H. Gay & Co., one of the American bondholders, and an offer made by Mr. Gay to sell out for $1,300,000 I refused. Finally we compromised on $1,250,000.

I thought you might feel interested in this long struggle; therefore I have gone somewhat into detail. I also enclose you a copy of a circular I issued during the last fall campaign and a copy of my message to the council this spring.

Yours truly,

Henry Truelsen, Mayor.

Duluth, Minn., Dec 4, 1897.

(We have commented briefly on this letter in our editorial columns.—Ed.)

"When in Rome do as the Romans do."

Sir: My last letter was from London, the center of the world's finance. To-day I write from Rome, the center of the world's history, as we Anglo-Saxons view history. Here history is ever present in the minds of the thinking men, and it becomes natural to take to archaeology. I, therefore, turned engineering archaeologist, one of the throng of students ever present in this great city, and with ten, or a hundred times more raw material to work upon than any ordinary vacationist can dispose of.

I spent an interesting day in the company of Prof. D. Spalaro, one of Italy's rising young men, I should say, and one of the ancient guild of the "fontanieri." We went over the Aqua Felice, which supplies Rome daily with about six or seven million gallons of water. This aqueduct and one or two others are owned and operated by the city; while as much more is delivered, partly directly and partly by primary sale to the city, by a private water company, the Aqua Pia, controlling the ancient Marcian Springs. Altogether, the modern Roman is rather profuse in his waste, not use of water. As near as I can determine, from a mere preliminary glimpse at the actual facts, the Roman citizen makes way with about 60 gallons per inhabitant per day, which is an enormous quantity viewed from the standpoint of the average European. This consumption is largely due to the form of contract under which water is furnished; a contract based upon irrgation practice and which confers the right to draw a specified quantity 24 hours per day. Human nature is such that, with a given right of this sort, one will cause the water to flow during the prescribed time whether it is needed or not. This is but another example of the tenacious hold of old customs and contracts upon the mode of life of a people. The ancient Romans had a right of this kind, and this out-of-date form of water supply is adhered to in the modern city.

I saw several "castelli" at work, a modified form of the "water-inch," and used as meters for both small and large supplies, for the purchase by the citizens and the purchase by the city from the Aqua Pia. This form of meter presupposes a draft from an open conduit and a continuous flow, or, at least, liberty to draw the maximum quantity sold or bought. It is necessarily accompanied by a wastful draft of water, as the above analysis may have already convinced the hydraulic reader.

Some 80 or 90 miles from Rome, on a steep mountain boldly rising out of a broad, flat valley to a height of about 1,700 ft., is situated the celebrated Benedictine Monastery of Montecassino. It was founded by St. Benedict himself a trifle of 1,368 years ago. Without going into its interesting history and its many side services to civilization, let it suffice in this place to note the debt owed to it by the science of hydraulics and by hydraulicians. Here Pietro Diacano, afterwards Abbot of the monastery, wrote with painstaking hand, about 1160, that copy of Frontinus, on the Water Supply of Rome, which was destined to be the means of preserving that treatise for the edification of succeeding generations. Here also lived and wrote Castelli, the pupil of Galileo, who announced for the first time the fundamental theory of the laws of efflux. It is something of a sensation, to the pilgrim student, to hold in his hand the original writings of men like these, to look out upon the valley they no doubt loved to feast their eyes upon, and to occupy a cell which perhaps they occupied.

It will interest Americans to learn that the Abbot of Montecassino, the successor to the bishopric of St. Benedict, founded nigh 1,400 years ago, is an American, formerly of Baltimore; and a most kindly, warm hearted, gentle man and gentleman those who are received by him will find him to be.

Instead of transcribing works with the pen; instead of coloring illustrations by hand and making a work of art of a single letter in a single book; the hard working Monks of St. Benedict, now having the custody of Montecassino, have called to their aid modern inventions, and by means of photography, lithography and printing they are making their literary treasures the common property of mankind. These accumulated treasures of theirs are no small matter; and it was with entire reason and propriety, therefore, that when monasteries were suppressed by law in Italy, the learned world called the attention of the Italian government to the fact that Montecassino was much more than an Italian monastery, and that its literary treasures were the world's treasures. These arguments prevailed with the Italian government, and Montecassino was declared to be a "national monument" and the Benedictine Order was left in possession as its custodians.

Some day I hope to be able to show to the readers of Engineering News, among others, what I found at Montecassino.

"2 Wall St."

Rome, Nov. 26, 1897.

Concerning South American Engineering Enterprises

Sir: In view of the fact that South American projects will from now on occupy more than ever the attention of American capitalists, any information, such as that furnished by Mr. Chibas in your issue of Dec. 9, regarding the durability of timber in the tropics, is interesting.

The feasibility of any project as a remunerative commercial undertaking depends largely upon the cost of installing it, and this cost is determined by the engineer's estimate. In the United States such estimates can be very closely made, because exact prices and cost of transportation can be easily obtained and time of delivery approximated within reasonable time. Not so, however, in regard to South American work. It is true that we can figure with equal certainty upon all material shipped from the United States; we know exactly the cost of everything, f. o. b., freight rates may be contracted for, and duties and cost of unloading can be very closely ascertained. The difficulty comes in in connection with the material to be furnished by the locality where the work is to be done. One large item of the cost of any engineering project is the timber required, either in permanent or temporary structures. One scarcely realizes the immense amount of timber which is lavishly used in engineering work in the United States until he comes to carry on such work in countries where it is scarce, or, what is the same thing, expensive.

In estimating the cost of a projected railroad in South America that of ties and ballast forms an important and uncertain factor. If banks of suitable material for ballast are found near by, so that the contractor can easily load it on his cars, this question is readily solved, but if he has to make local agreements for its collection and delivery he never knows what it is going to cost. He can only tell on the completion of the work what it has cost him. In regard to ballast, however, in case of any difficulty of this sort occurring, there is always one way out of it—the track can be laid without ballast. The rails, however, cannot be laid without ties, and it is in this connection that the information contained in Mr. Chibas' letter is valuable.

In most of the South American countries no timber can be found to permanently resist the climate and attacks of insects but certain very hard varieties of native woods. Frequently it is difficult to get the right kind in sufficient quantities, as wanted; it is always expensive in first cost and also in laying. These woods are very heavy, and therefore slow to handle, and are so hard that holes must be bored for the spikes. In the case of a projected narrow-gage road in Venezuela on which I estimated some two years ago the closest figures that I felt justified in using for ties of native wood brought this item up to a sum exceeding by 50% of the estimated cost of the rails.

In estimating the cost of railroading in these countries, all depends upon which of the two radically distinct ideas the whole project is based upon, and this selection depends largely upon the amount of cash capital which can be controlled. If this is adequate, and the ascertained commercial prospects of the undertaking seem to justify it, there is no doubt that in the tropics, as everywhere else, the true policy is to install the road at once in the best manner possible, using, among other things, expensive and durable ties. If, however, as is generally the case, the capital is limited, and the project, as still more generally occurs, is a tentative one, embracing elements of both success and failure, I believe the true policy will be to build the road as quickly and cheaply as possible, shipping Southern pine ties from the United States and bending every effort to get the first train running over it. In other words, to demonstrate by an actual trial what the business of the road is going to be. If this proves to be remunerative there will be no trouble in getting as much money as is needed to systematically rebuild the road on a permanent footing. If not, ——.

The great stumbling block in the way of these foreign enterprises is the timidity of capital in entering an untried field. When a concession has been obtained from the government of the country for a railroad, water-works, or what not, the effort is generally made to incorporate a company and issue and negotiate bonds to obtain money to execute the work. It is very soon found that to negotiate the bonds of a road which is not yet in existence, and which, when in existence, will be located in a South American Republic, is an uphill work. If, as is very unlikely, these bonds are finally placed, it will be at such a discount as to saddle the enterprise with an interest account effectually disposing of dividends, if it does not produce a deficit, necessitating the borrowing of more money to satisfy it. We have heard of this sort of thing outside of railroading.

There is only one way to make a success of any such work, and that is, when the concession has been obtained (usually the easiest part of the whole business) and passed upon by a competent international lawyer, for the promoters and their friends to finance the scheme themselves. Of course, some projects are too vast to be handled in this way, and then the slow machinery of prospectuses, expert reports, etc., must be set in motion, and probably a few trips to London undertaken; but there are many smaller ones which can only be done justice to by operating in the compact and self-contained way outlined above.

I see I have got a little off the immediate topic of durable ties, but in these matters one thing leads to another, which must be my excuse.

E. Sherman Gould.

Yonkers, N. Y., Dec. 10, 1897.

The Actual Railway Situation and the Alleged Opportunities for American Engineers in China.

Sir: My attention has been called by many of the readers of your valuable journal to the letter of "Andrei Kimta," published in your issue of Aug. 5, under the above heading. In this letter my name appears in anything but an enviable form. The letter is well written and calculated to impress its readers with fact and fairness, or I should not spend a moment's time in answering it.

The writer says: "As to the Hankau line—the English, French, German and Americans have been fighting and scheming for this concession for the last two years. About fifteen months ago this line was put entirely into the hands of a high mandrian, Sheng Tao-tai (Tao-tai is a title), with orders to procure the necessary funds and proceed with the work. The Imperial Government was to [illegible] 10,000,000 taels (a tael is about 70 cts. in gold). Sheng said the Chinese would subscribe ten millions, and about twenty millions were to be borrowed from foreigners. A large English syndicate kept a man in Peking on this scheme for two years and got nothing. An American, Col. Jefferds, seemed to think it belonged to him, for some unknown reason, and when he did not get it did a great deal of injudicious writing in the English-Chinese papers, which, to say the least, has not improved the chances for Americans with the Chinese. The Brice syndicate, represented by Col. Bash, worked long and hard in a most business-like manner, and at one time it seemed as if they would be successful, but nothing materialized, owing to a question of security."

That the reason of my claiming the right of building this line of railroad may no longer remain "unknown," I beg to state that in December, 1894, I was sought out by Mr. Sung Yu-jen, Secretary, and Wong Fung-hou, attache, of the Chinese Legation in London, to assist them in procuring ships, and arms and munitions of war. Early in 1895 His Excellency Wang Tche-tchoung, His Imperial Highness the Emperor's Special Envoy, came to London and from thence went to Paris, to conduct negotiations, where he remained until the close of the war. I was in daily communication with His Excellency, but no purchases were concluded, therefore no commissions could be paid. His Excellency fully appreciated my labors and the loss of time and money I was subjected to consequent upon the government's failure to purchase. He invited me to return with him to China, and promised to obtain for me contracts for building railways or public works that would not only reimburse my loss of time and money, which he had no authority or power to pay, but would pay me handsomely for my labors.

I could not arrange to go with him, but on June 22, 1895, in company with Wong Fung-hou and Mr. Spencer Payne, my secretary, I sailed from Southampton for China via New York and Vancouver. I found, in Shanghai, His Excellency Wang Tche-tchoung, waiting my arrival. We formulated two bases of operations for trunk lines of railway in China. What was termed the South and North line, from Canton via Hankau to Peking, was selected as the one best suited to overcome objections and superstitions, and the one most likely to be approved by the government, as it was in the interior and far away from the sea-coast where no foreigner could utilize it in making a raid upon the capital. His Excellency directly thereafter went to Peking to report the result of his foreign mission to the Emperor. While in Peking the subject of railways was discussed. Princes Kung and Chung were requested by His Imperial Highness, the Emperor, to appoint Hsu Ta-jen (Ta-jen means His Excellency), Ex-Treasurer of Canton and a nominee of His Excellency Wang Tche-tchoung, to collect the capital and organize a company for the purpose of building the northern half of the line, viz., from Peking to Hankau, believing the whole line to be too great an undertaking for the moment.

Previous to this the projected trunk line to Peking was located upon the heel-path of the Grand Canal, and that is where all the schemers and speculators your correspondent speaks of wanted to build a road, because the embankment was already made and they could get pay for work they did not have to do. The impossibility of maintaining a railway on the banks of the Grand Canal, that had been used for centuries as a channel for commerce, and is now being used by hundreds of thousands of sampan and junk men, whose avocation it would destory, was apparent to me, and I could not recommend capital to invest in such a scheme. The capital to be raised for the Peking & Hankau line was set at 30,000,000 taels (a tael being at that time 80 cts. gold). Foreigners were allowed to subscribe for one-third of the capital. With the understanding that myself and friends could have the contract for building and equipping a first-class 4 ft. 8½-in. gage railway, of the American type, upon this line, for a sum not to exceed 40,000 taels per mile, and that the shares we would take in the company should be preferred to the extent of 5%, cumulative. I underwrote the ten million taels allowed to be subscribed by foreigners on Feb. 6, 1896, and Col. Bash, the representative of the Brice syndicate, saw the agreement and he then and there pledged himself not to interfere with my negotiations, and I agreed to help him all I could, and I have, upon more than one occasion, put myself out of the way to do so. On Feb. 7 I sailed for San Francisco and went from thence to New York and London, in which city I remained five days and then returned to China prepared to carry out my contract.

Mr. Wong Fung-hou, whom I had taken from the Chinese Legation in London, remained in Shanghai as my trusted agent, correspondent and interpreter. The "business-like manner" in which your correspondent says that Col. Bash, the representative of the Brice syndicate, conducted his affairs, was to capture my representative the second day after I left Shanghai and with him connive to get Hsu out and get a man in with whom he could work. They did it and "got left," as they should have been; but your correspondent says, in regard to Col. Bash's labors, that "nothing materialized, owing to a question of security!" He evidently does not believe there is a God in Israel.

In evidence of my statements I am ready to give you all of the original papers and detailed facts in regard to my contract, if you require them, as also a copy of the authority given Hsu Tajen by the Princes, with their great seals attached. I may mention here that Prince Kung is the chief of the Tsungli Yamen. Whether, under the above circumstances, I had any right to a recognition or not I leave it for your good readers to judge.

Your correspondent further says: "On the new line to Peking nearly all of the masonry is of Portland cement, owing to the great expense of suitable stone. The entire line has at least one foot of broken stone ballast. No expense or careful engineering superintendency have been spared to make the railways thoroughly first-class in every respect, and the lines now built and in operation will compare most favorably with some of our best roads in the States." I doubt very much, from the above statements and others in his letter, whether your correspondent is a naturalized American or not; in fact I have my doubts about his ever having been in the United States or ever having seen an American railway. I have been in the railway business a greater portion of the time since 1854, and have inspected nearly all of the principal railways in the world, and I will say to you now that the present railway in China, with its equipment, is the greatest pasticcio or mongrel in railways that I ever saw. I have been several times over the new line from Tientsin to Peking, and from the nature of the soil, which is wholly alluvial, from the uncertainty of foundations, and from the cost of transporting materials, I would never think of building permanent bridges or culverts of stone or concrete until my roadbed had settled and I knew for sure where I stood. The average embankment is from 8 to 10 ft. high, of spongy alluvial loam that melts like sugar when water comes in contact with it, and if it does not settle from 12 to 20 ins. within two years I will eat my boots. It is not economy for the government, for the shareholder, or for the people to have such permanent structures built at first, as the cost of bringing the "stone-ballasted" roadbed up to the level of the bridge abutments, to say nothing of the extra cost of handling material, would be erroneous. In this instance there was a big "pull" in the concrete work, and it is a wonder to me that with the contract held by the insiders the whole roadbed was not built on a concrete foundation.

As to the articles I wrote for the Chinese press they were facts, and facts to some people are very stubborn things.

In conclusion, permit me to say that I am still negotiating on Chinese affairs and my chances look to me as favorable as those of any of my opponents. Two years ago, while in Peking, the representative of the strong English syndicate, of which your correspondent speaks, censured me greatly because I offered to build railways for the Chinamen so cheaply. I did not go to China for the purpose of robbing the people, but to help them. I was satisfied with a clear 10% and let them have 90, instead of taking 90% and giving them only 10, as has too often been the case with others.

Yours faithfully, M. R. Jefferds.

66 Broadway, New York, Sept. 20, 1897.

(We submitted a proof of the above letter to Senator Brice for transmission to Col. Bash, to give the latter opportunity to make reply in the same issue, if he so desired. No reply being received from Col. Bash, after the lapse of nearly three months, we give space to Mr. Jefferds' letter. —Ed.)

Notes and Queries.

M. H. writes: "I was especially interested in your article in Engineering News of Oct. 14 on the construction of street railway tracks in Minneapolis and St. Paul, where you described the method of cast-welding the joints. I am anxious for further information as to the success of these joints after a year or two of wear, and would like to hear from other roads who have used similar methods."

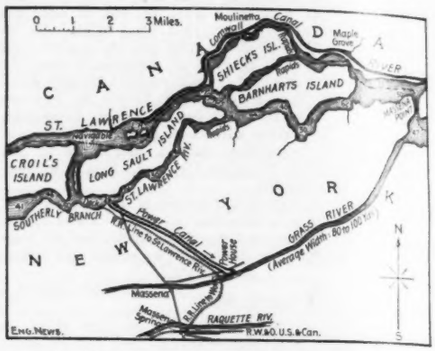
So far as our information extends, the experience with these joints as a mechanical connection of the rail ends has been very favorable. We believe, however, that some tests have indicated that the electrical resistance of these joints increases considerably after a few months, and that it will still be advisable to use rail bonds where these joints are used. We shall be pleased to hear from any of our readers who can give further information.

PROGRESS OF THE WATER POWER PLANT AT MASSENA SPRINGS, N. Y.

By Ofrin E. Dunlap.

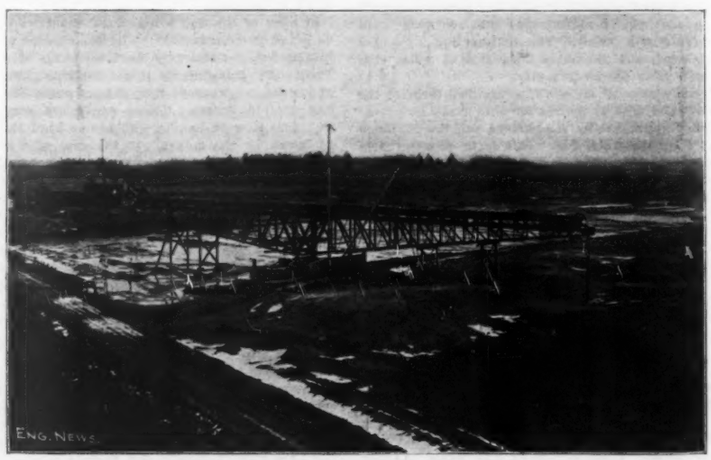
The approach of winter finds work well under way on the Massena power project, with prospects that next spring the several contracts will be pushed with additional vigor. This project for developing a large amount of power in the Northern section of the State of New York has attracted much attention, and well portrays how ready capital is to invest in the development of water powers. When the plant is completed in its entirety it will be capable of developing 150,000 HP., it is expected. Contracts have been awarded for supplying the necessary machinery to develop half that amount, or 75,000. While the general contract for the construction of the canal and power house is in the hands of the Lehigh Construction Co., of South Bethlehem, Pa., a company which, it is understood, bears the same relative position to the St. Lawrence Power Co. that the Cataract Construction Co. does to the Niagara Falls Power Co., the contracts have been sublet. Contractor Corbett, of Omaha, Neb., will do work on the two levels between Grass River and Andrews Ridge and between Andrews and Alden ridges. John W. Crelin, of Hazelton, Pa., will do work near the power house site, while Dick Brothers, of Omaha, and Mr. Barry, of Oswego, have the contracts for levelling from the St. Lawrence through the flat to what is known as Alden's ridge. A railroad has just been completed along the route of the canal for a distance of three miles, and two miles more of road are yet to be built from the depot to the site of the power house. This latter piece of road will be two miles long and will cross the Racquette and Grass rivers. The permanent bridges will be of iron and the abutments of stone and concrete, the stone to be obtained from the Chaumont quarries. This piece of road will probably be completed in the spring.

The plan contemplated for the development of



Map of Water Power Canal at Massena Springs, N. Y.

power at Massena is to divert a certain portion of the water of the St. Lawrence River from its natural channel by means of a surface canal that will carry it three miles across country to the Grass River, where it will fall upon turbines and pass by way of the Grass River, which will practically be the tail race, to the St. Lawrence at a point lower down stream. Thus the water will be but temporarily diverted from its natural channel. At the point where the entrance to the canal will be located on the St. Lawrence the Long Sault rapids are located, giving a fall of about 50 ft. To the south from the shore of the St. Lawrence there is a comparatively level plateau reaching to the Grass River valley, the water in which is about 45 ft. below that of the St. Lawrence at the entrance to the canal. The canal in building will be 225 ft. wide and 25 ft. deep. It will be about three miles long and run in almost a straight line from the St. Lawrence to the Grass River, the head of water on the turbines to be about 40 or 45 ft. The dimensions and length of this waterway will, of course, necessitate much excavation, but as the material is mainly sand, clay and gravel, the expense will not be large compared with what it would be if the canal had to be built through rock. In order to facilitate the excavation of the canal a new form of dirt conveyor has been designed by Engineer Rice of the Lehigh Construction Co., and this machine is expected to do very rapid and effective work. To some extent it resembles a derrick. It is 230 ft. long and 60 ft. high. It is mounted on trucks which will run on a temporary railway track laid on the bed of the canal. As rapidly as the steam shovels can loosen the earth,



VIEW OF CANAL LOOKING NORTH FROM MASSENA POWER HOUSE, SHOWING PORTION OF FINISHED CANAL AND TRAVELING CONVEYOR FOR USE IN EXCAVATION.

the buckets of the conveyor, which will be operated on an endless chain, will pick it up and carry it to the far end of the machine, where it will be deposited well outside of the line of work. The location of the entrance of the canal on the St. Lawrence has been selected so that a promontory will deflect all ice and drift from coming down stream to the opposite shore.

The power house in its complete form will be between 500 and 600 ft. long, with a width of 130 ft. Its design calls for a handsome structure. It will stand upon a solid rock foundation. The water for power will flow from the canal, which will terminate on the bluff in the rear of the power house, to the turbines through penstocks, and the rock in the bed of the Grass River will be removed to the necessary extent in order to allow a free flow of water from the wheels. The idea of the canal terminating on the bluff, the power house located below, and the river serving as a tail race, is very much on the same principle of development to be found in the plant of the Niagara Falls Hydraulic Power & Manufacturing Co. at Niagara Falls, which company owns the surface canal there. But in the power house conditions will exist quite unlike anything to be found in either of the power houses at the Falls. Instead of a horizontal turbine on a vertical shaft, such as is to be found in the plan of the Niagara Falls Power Co., the Massena power house will have vertical turbines connected to horizontal shafts. The generators will be mounted on the same shaft as the turbines but 80 ft. distant from them, and four turbines will be required to operate each generator. Thus as 15 generators, each of 5,000 HP. capacity, have been ordered for the initial installation, it will require no less than 60 turbines to run them. The turbines are being made by the Stillwell-Bierce & Smith-Vaile Co. of Dayton, O. They will be of the Victor type, well calculated to obtain great speed from a comparatively slow-moving body of water.

The generators to be used in this plant will be the product of the Westinghouse Electric & Manufacturing Co. It is a notable fact that they are to be of the same capacity as those built by the Westinghouse Company for the Niagara Falls Power Co. The weight of each machine will be about 350,000 lbs., the weight of a single piece being as much as 125,000 lbs. Their height will be about 22 ft., and each machine will occupy a floor space of 22 × 18 ft. Their speed will be 180 revolutions per minute, and they will be of the three-phase class.

The St. Lawrence Power Co. was organized under the laws of New York State with a capital stock of $2,000,000, which was afterwards increased to $6,000,000. It is officered as follows: President, Walter C. Lane; Vice-President, S. H. Gardyne Stewart; secretary, Carlton H. Reeve; treasurer, William C. Cox. English capital is said to have become interested in the development at Massena.

As in many other projects, several people now claim to have been the sole originators of the plan of development, whereas the fact is the success met with so far should be conceded to be the results of earnest efforts of various interested persons.

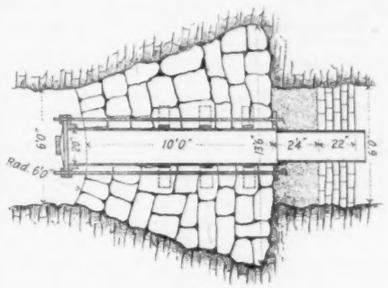
A MASONRY DAM UNDER 640 FT. HEAD.*

By William Kelly,† M. Am. Inst. M. E.

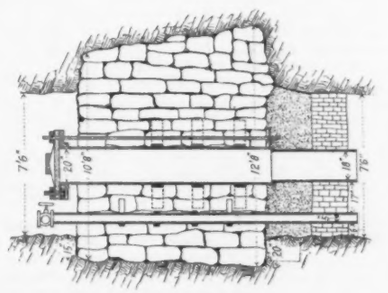
An exploring-drift on the bottom level of the Curry mine, at Norway, Mich., on the Menominee range, cut a stream of water, which increased considerably the expense of pumping. The hope that the supply would drain off was not realized. It was decided to build a dam in the exploring-drift, as it was estimated that the cost would be recovered by the saving in fuel in less than two months.

The eighth and lowest level of the mine is 780 ft. below the surface. The exploring-work had started north from the shaft at right angles across a slate to a jasper formation parallel to that which contains the principal ore-body. In this north jasper several hundred feet of drifts had been opened in different directions. The dam was located in the slate near the jasper. The drift at this point is 6 ft. wide and 7½ ft. high. The amount of water enclosed by the dam would be less if it had been built nearer the face of the openings; but the jasper, though hard to drill, is not firm, while the slates, though softer, are dense and solid, and the impermeability and strength of the adjoining measures were of commanding importance.

The dam was built of local sandstone in the shape of an arch upon its side, with a radius of 6 ft. and a thickness of 10 ft. The mortar was made of 1 part Hilton cement and 2 parts sharp sand. The abutments were formed by cutting out the sides of the drift in line with the center of the curve of the arch, but leaving the rock rough. The floor was excavated 15 to 20 ins. below the bottom of the drift, and the top was made 2 ft. higher in front and 5 ft. higher at the back. In laying the masonry the front courses of stone were cut to fit the arch and care was taken, particularly at the top, to leave no crevices. Two



Plan.



Longitudinal Section.

Dam in the Curry Mine at Norway, Mich.

openings were left through the dam: one, a 5-in. pipe to carry off the water, fitted with a gate-valve at the outer end; and the other, a man-way of 20-in. steel pipe, plain at the inside end, and with a heavy flange shrunk on at the other, to which a heavily ribbed blind flange, 2½ ins. thick, was bolted. A small pipe tapped into the blind flange carried a hydraulic pressure-gage. The 20-in. pipe was anchored in the masonry by three clams, and the flanges were bolted to three long rods passing through the wall with washers inside. The 5-in. pipe, with a flange on the inside end, was also anchored by three clamps, the arms of which radiated in different directions. As it is nearly 800 ft. below the surface, and the source of the water was unknown, the pipe and fittings were designed to withstand a pressure of 350 lbs. to the square inch.

The water was shut off about 4:30 p. m., May 13, 1897, and a little before noon the next day the pressure was 100 lbs., rising to 215 lbs. at 3:30 and 240 lbs. three-quarters of an hour later. The dam leaked about 30 gallons a minute, the quantity increasing with the pressure. This condition was not satisfactory and the water was let off. In two hours the pressure fell to 45 lbs., and the water rose at the shaft about a foot over the floor. A high pressure was produced by a small quantity of water, showing that part of the water-course was very small.

The closing of the dam seems to have increased the flow. For the thirty days previous, the record of the pumping, measured by displacements, gave an average of 370 gallons per minute. After opening the dam, the average for fourteen days was 413 gallons.

To put in an impervious stratum, a brick wall 22 ins. thick was built 2 ft. 2 ins. from the inside of the dam and the space between was filled with concrete. This was made by mixing four parts of limestone, broken to egg-size, with three parts of cement mortar. A short length was added on the inside to the 5-in. pipe, and a piece of old smokestack, 18 ins. in diameter, was used for lining the extension of the man-way. Owing to the increase in the water after the dam was opened, there was some delay in draining the mine, and it was 17 days before the addition to the dam was completed. Before closing it, three loads of horse-manure were put against the brick work and held there by a plank partition.

The water was shut off the second time on June 1, at 9:30 a. m. While the water was accumulating in the drifts, the pressure increased slowly. The following are the readings of the gage taken every two hours, beginning eight hours after the dam was closed:

Date.	Time.	Pressure, lbs. per sq. ft.	Equivalent head of water, ft.	Increase in 2 hrs., ft.
June 1.	5:30 p. m.	5	12	..
"	7:30 "	13	30	18
"	9:30 "	22	50	20
"	11:30 "	30	70	20
June 2.	1:30 a. m.	45	105	35
"	3:30 "	71	165	60
"	5:30 "	130	300	135
"	7:30 "	220	510	210
"	9:30 "	260	600	90
"	11:30 "	268	620	20
"	1:30 p. m.	270	622	2
"	3:30 "	271	625	3
"	5:30 "	272	628	3
"	7:30 "	273	630	2

On June 8 the pressure was 277 lbs. to the sq. in., equal to a head of 640 ft. and the total pressure against the dam was over 800 tons.

During the morning of June 2, before the pressure had reached the maximum, the water which flowed from the dam was collected in a small stream and caught in a pail. It took 22 seconds to fill the pail, which held a little over 19 pints, showing a flow of about 7 gallons per minute.

The second day after, though the pressure was higher, the flow had decreased to 5 gallons, and four days later it had fallen to 2½ gallons per minute. The water which came through the dam trickled out in eight or ten different places, most of them near the top or one side. The water was milky and left a heavy calcareous deposit on the face of the dam and in the ditch. After the dam was closed, the record of the pumps for six days showed that the mine was making 115 gallons of water per minute, a decrease of 295 gallons.

The cost of the dam was as follows:

For stone, brick and sand at top of shaft	$41.25
" cement	151.70
" pipes, valves and gage	95.00
" labor sending down materials	16.54
" " breaking stone for concrete	17.77
" " cutting out drift	21.00
" " building dam	141.01
Total	$484.27

The stone was taken from an old foundation, and the cost of quarrying is not included.

MACHINE MOLDING WITHOUT STRIPPING PLATES.*

By E. H. Mumford, M. Am. Soc. M. E.†

Molding machines may be classed under three heads. First, machines which only ram the molds, and, when the ramming is done by means of a side lever, by hand, are generally called "squeezers." Second, machines which only draw the patterns, the ramming being accomplished by the usual hand methods. Third, machines which both ram the molds and draw the patterns, ramming either by a hand-pulled lever or by fluid pressure on piston or plunger and drawing the patterns through a plate called a "Stripping Plate" or "Drop Plate"—till recently the usual method—or, without the use of this plate fitting everywhere to the pattern outline at the parting surface, the patterns being effectively machine guided in either case.

It is to the third class that the machine described in the paper belongs.

In the stripping or drop plate method of drawing patterns the patterns are not rapped at all and are drawn in a practically straight line so that the mold is absolutely pattern size.

The stripping plate is fitted accurately to every outline at the joint surface of the patterns, obviously at considerable expense, and, of course, at the instant of drawing the patterns, supports the joint surface of the mold entirely. This is, at first sight, an ideal method of drawing patterns, and it has for years been the only method practised on machines. It has two disadvantages. The patterns are separated from the stripping plate by the necessary joint fissure between the two. Fine sand continually falls into this and, adhering to the joint surfaces more or less, grinds the fissure wider. This leads to a gradual reduction of size of patterns on vertical surfaces and a widening of the joint fissure often to such an extent that wire edges are formed on the mold, causing, on fine work, "crushing" and consequently dirty joints. A nicely fitted but worn plate of 28 pieces which had cost, at shop expense only, $250, was recently replaced by a plate of 28 pieces, fitted ready for the machine under the new system about to be described, for not more than $25.

The stripping plate method has another drawback, not always appreciated, probably because accepted as inevitable. Stripping plate patterns are not rapped, and there frequently occur on surface of patterns, remote from the action of the stripping plate, rectangular corners just as important to mold sharply as those at the parting line. Such corners have either to be filletted or "stooled" in stripping plate work, and neither method often is practicable. When the entire pattern and plate are vibrated so that the corners where the pattern joins the plate draw perfectly, as they do in the machine to be described, it is obvious that similar corners anywhere on pattern surface will draw equally well.

The vibrating of patterns, or rather of molds, during the operation of drawing the patterns possesses little of nov-

* A paper read at the Duluth meeting of the American Institute of Mining Engineers.

† Vulcan, Mich.

* Condensed from a paper read at the New York Meeting of the American Society of Mechanical Engineers.

†Sec. and Treas., Tabor Mfg. Co., Elizabeth, N. J.

city. Ever since a bench molder's neighbor first rapped the bench while he lifted a cope or drew a pattern, the thing has been done in one way or another. In fact, machines are now and then found on the market in which a device like a ratchet or other mechanical means for jarring the machine structure during pattern-drawing renders the working of easy patterns without stripping plates possible.

The idea of applying a power-driven vibrator directly to the plate carrying the patterns to thus vibrate them independently of other parts of the machine and the flask and sand, has been the subject of the issue of patents to Mr. Harris Tabor.

The pneumatic vibrator consists simply of a double-acting elongated piston having a stroke of about 3-16-in. in a valveless cylinder, and impacting upon hardened anvils at either end at the estimated rate of 5,000 blows per minute.

The action of the vibrator is such as to give to the entire pattern surface an exceedingly violent shiver, making it impossible that any sand should adhere to this surface, while the magnitude of the actual movement of the pattern is so slight that it is found to fill the mold so completely that it is impracticable to draw it a second time without rapping. Yet, so truly are the patterns held, and so little disturbed from their original position, that it is perfectly practicable to return patterns to a mold having the finest ornamental surface in the ordinary practice of "printing back."

As illustrating the importance of being able to work without stripping plates on a line of work which is much more extended than that possible with them, we may say that a machinist with a drill press, supplied with split patterns and planed pattern plates has matched and fixed five sets of from four to eight pieces in a day; and wooden patterns fitted for temporary use in the same way are of frequent occurrence when it is not thought wise to go to the expense of metal patterns on account of the relatively small number of castings to be made from them.

THE COST OF CLEANING CARS is given as follows in the Proceedings of the St. Louis Railway Club by Mr. J. A. Gohen, Master Painter of the Cleveland, Cincinnati, Chicago & St. Louis Ry.: wiping outside of coach, sweeping and dusting inside, cleaning windows and saloon, 42 cts.; washing steam pipes, washstand and window sills, and spraying with formaldehyde, 22 cts.; scrubbing outside of coach with "Modoc," $1.95; parior or dining-car, $2.10; baggage car, $1.60, and mail car, $1.05. Cleaning thoroughly with powdered soap inside, blowing cushions with compressed air and spraying with formaldehyde, $1.98. General cleaning of dining-cars, $2.07. Average cost of cleaning, 60 cts. for day cars and 40 cts. for combination cars.

THE INDIANAPOLIS THREE-CENT STREET RAILway fare ordinance has been declared invalid by the U. S. Court of Appeals. The decision states that since the company was incorporated under the general laws of the state an amendment to those laws, applicable to all cities in the state, is the only legal method of providing for a reduction in fares.

0.3631 CTS. PER HP. PER HOUR from coal to feeders is a record made by the electric power plant of the Metropolitan Street Ry. Co., of Kansas City, Mo. The power house contains six 250-HP. Babcock & Wilcox boilers working at 200 lbs. pressure. Chain grate stokers, Hunt conveyors, coal storage bins, etc., are employed in handling fuel and ashes. A Berryman feed water heater of 3,000 HP. capacity, operated by the exhaust steam from the Worthington condenser pump, boiler feed pumps and stoking engine also reduce operating expenses. At present only one engine, a 2,000-HP. tandem compound condensing Corliss is installed. This has cylinders 30 and 60 ins. and a 48-in. stroke. A 60-ton flywheel 208 ins. in diameter is mounted upon the shaft, which normally runs at 80 revolutions per minute. The generator was furnished by the Walker Co., Cleveland, O., and is a 550 volt, 2,400 ampere direct connected machine with an armature 10½ ft. in diameter and a 14 pole field. The current generated is used to operate an ordinary electric trolley road, as well as a large electric motor, which drives the machinery of a cable railway. On one occasion this generator was loaded to 2,700 amperes, at which time there were 63 motor cars and 8 trailers on the electric road and 20 grip cars and 25 trailers on the cable road.

WORK ON THE NEW EAST RIVER BRIDGE had reached the following state of progress, according to the report of the Chief Engineer, Mr. L. L. Buck, M. Am. Soc. C. E., made Nov. 30:

Tower foundations, north caisson, New York side—Excavation of rock has continued and the cutting edge has reached a depth of 54.36 ft. below mean high water, about 5 ins. above the plane at which we expect to stop sinking unless it should be found necessary to go deeper. From present appearance a depth of 54.81 ft. below mean high water will be sufficient, and if so, concreting of the interior will begin immediately on reaching that depth.

South caisson—Concreting on top of this caisson has proceed at intervals, and the work of placing in its exact position is going on.

Anchorage—The work of driving the sheet piling around the boundaries to form the cofferdam preparatory to excavating the earth has continued. Piles for the temporary pier have been driven and capped.

WEATHER TABLE FOR NOVEMBER, 1897. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	31.0	60	4	56	—	34	SE	4.86	1.57	
	Portland, Me.	36.3	57	11	46	7.9	32	NE	6.69	2.00	
	New York City	44.1	66	21	45	15.1	54	W	4.44	2.26	
	Pittsburg, Pa.	44.9	69	19	50	7.7	30	W	5.11	1.19	
	Chicago, Ill.	38.7	66	7	59	—	55	SW	3.06	0.85	
	Omaha, Neb.	36.5	71	— 2	73	8.1	31	NW	0.14	0.10	
	St. Paul, Minn.	29.3	69	— 8	77	7.2	28	NW	0.93	0.27	
	Duluth, Minn.	—	—	—	—	—	—	—	—	—	
	Bismarck, N. Dak.	25.1	72	—15	87	8.0	36	NW	0.25	0.10	
	Average	35.5	66	5	62	9.0	38		3.18	1.04	
Southern Cities.	Washington, D. C.	46.0	76	26	50	7.2	47	NW	3.31	1.38	
	Louisville, Ky.	48.1	72	20	52	9.4	40	SW	5.86	1.46	
	St. Louis, Mo.	46.1	74	16	58	10.7	57	W	6.21	1.40	
	Savannah, Ga.	61.2	80	40	40	8.0	26	NW	0.71	0.37	
	Kansas City, Mo.	43.9	79	7	72	9.8	30	NW	1.25	0.74	
	Jacksonville, Fla.	65.3	83	46	37	7.1	30	SW	1.56	0.94	
	Chattanooga, Tenn.	51.4	76	29	47	7.3	45	W	1.18	0.41	
	New Orleans, La.	63.7	82	44	38	8.7	34	N	3.38	2.38	
	Memphis, Tenn.	53.0	77	26	51	11.7	49	NW	5.00	1.38	
	Palestine, Tex.	57.8	84	30	54	7.3	22	SE	1.30	0.80	
	Average	53.6	78	28	50	8.7	56		2.98	1.13	
Western Cities.	Helena, Mont.	28.2	69	10	79	6.1	38	SW	2.22	0.60	
	Port Angeles, Wash.	41.1	57	24	33	5.6	30	W	6.03	1.78	
	San Francisco, Cal.	53.1	68	44	24	—	29	W	1.08	0.42	
	Salt Lake City, Utah.	43.2	68	24	44	4.9	33	W	1.19	0.40	
	Santa Fe, N. Mex.	41.4	63	17	46	5.4	30	NE	0.08	0.04	
	Denver, Colo.	40.8	77	7	70	7.8	51	W	0.24	0.12	
	Yuma, Ariz.	62.5	88	38	50	—	32	W	0.00	0.00	
	Average	[illegible]	70	21	49	6.0	35		1.54	0.48	

Brooklyn side, tower foundations—The work of concreting on the top of this caisson begun on Nov. 24, has continued, and about 300 cu. yds. have been put in place. The walls have reached the full launching height, 19 ft. Before launching the vertical wall timbers are to be put in, to consist of outer planking, to be put in place of truss planking above the roof. The vertical 2-in. steel rods and the working shafts are yet to be placed, requiring two weeks longer.

Anchorage—The removing of buildings and the building of a temporary trestle have progressed.

THE GREAT WISCONSIN MONOLITH, 115 ft. long, 10 ft. square at the base, and 4 ft. square at the top, may be set up on the lake front of Milwaukee to mark the coming semi-centennial of statehood. This stone was taken from the red sandstone quarries of F. Prentice, at Houghton Point, Wis., and it was originally proposed to send it to the Chicago Exposition as a Wisconsin exhibit. But engineering and financial reasons prevented, and it has been left at the quarry until the present time. A movement is now on foot to ship it by water to Milwaukee, and there erect it. Plans and estimates have been made, and it is estimated that $40,000 to $50,000 will do the work. The claim is made that the stone is 10 ft. longer than any recorded single stone quarried in the world. But the granite obelisk at Karnac, mentioned by M. Mariette as the loftiest known, is 108 ft. high.

A 1,700-MILE CANAL, from Montana to Texas, is the startling proposition to be formally made by Gov. Leedy, of Kansas, to the coming Nebraska Irrigation Congress. The purpose of the canal would be to divert the flood waters of the Missouri and Mississippi valleys, impound them and let them down when wanted. The canal would tap the Missouri River at Milk River, in Montana, and empty into the Red River in Texas. The scheme is that of Ex-Lieut. Gov. Daniels, once a surveyor, but now a Kansas farmer. He mentions incidentally that the cost would be only a trifle of $360,000,000; but he believes that this sum could easily be obtained from the multi-millionaires by "imposing an income tax on the rich."

THE LOWEST BID FOR THREE 30,000,000-GALLON pumping engines for the new water-works of Cincinnati, on Nov. 30, was $296,250, a fourth engine to be furnished at the same rate, $98,750, if desired. The same firm, The Lake Erie Engineering Works, of Buffalo, submitted bids on two other designs for $340,500 and $370,500, respectively. Two local firms bid just a little above the Lake Erie's figure for their most expensive design, A. G. Moore & Co. tendering $379,000 and the Lane & Bodley Co. $387,000 for the three machines. Besides these two local concerns, the Laidlaw-Dunn-Gordon Co. put in a bid of $438,000, so that altogether three local firms bid, notwithstanding the claims of the opposition and some labor leaders that the specifications were so drawn that only S. P. Allis & Co., of Milwaukee, and the Southwark Foundry & Machine Co., of Philadelphia, could bid. As it turns out the Allis and Southwark bids were among the highest submitted by the eight competitors for the contract. Taking into account the alternative bids submitted, there are 15 different propositions to choose from. The several bids were given under Contract Prices, in our Supplement for last week. The pumping engines are to be self-contained, vertical, triple expansion, crank and fly-wheel machines.

GARBAGE DISPOSAL CONTRACTS were awarded in Chicago, Nov. 29, distributing the work among four contractors in five separate districts. The contractors must build a reduction plant in each district and have it in operation by March, 1898. The awards are as follows:

District 1—Comprising the North Side; Mulcaire & Burke, Merz reduction system, $350,000.

District 2—Comprising the South Side, Dowdle & Chamberlain, the Chamberlain reduction system, $790,000.

District 3—Comprising the West Side, south of Madison St.; Hanrahan & Downey, the Flinn reduction system, $349,312.50.

District 4—Comprising the West Side, north of Madison St.; Mulcaire & Burke, Merz reduction system, $384,509.

The contract is for five years, and covers the collection and disposal of garbage and other refuse, including ashes, the contractors not being obliged to remove the wastes of certain classes of large producers. The aggregate of the several contracts is $1,873,821, or about $375,000 a year. Of the successful bidders, it is said that Mulcaire & Burke have been local garbage contractors in some wards of the city for several years. Mr. Dowdle, of Dowdle & Chamberlain, is said to be a local masonry contractor, and Mr. Chamberlain a wholesale whiskey dealer of Detroit. Hanrahan & Downey are local contractors. The contract is for five years. Mulcaire & Burke bid $1,827,749 for the city as a whole. The division of the contract is said to have been made partly to test different systems of disposal. Mr. L. E. McGann is Commissioner of Public Works.

A CONTRACTOR'S SUIT has been brought against the city of Chicago in connection with the new northwest land tunnel, now under construction. Weir, McKechney & Co., the contractors for section No. 3, have brought suit to recover $68,000 and to have the contract altered. They claim that before accepting the contract they were informed by the city engineer that they would encounter only soft soil in making the excavations. This information, they say, was wrong, and the work had not progressed far when they encountered rock. On this account they were forced to do considerable blasting, which was an additional expense to them. The city finally agreed to a supplementary contract, allowing them certain amounts for extras. The bills for extras, it is said, were paid for a time, but finally the city refused to continue such payments. The contractors figure their actual claim against the city as $63,000, but seek to also recover for loss of time and court costs. They also ask the court to order the city to so alter the supplementary contract that certain clauses embodied in it will be also embodied in the original contract.

THE FORFEITURE OF THE DEPOSIT accompanying a contractor's bid on engineering work, when the contractor has failed to take up the contract awarded to him, has given rise to an interesting law suit in Chicago. When bids for garbage disposal were called for some months ago, each bidder was required to deposit a certified check for $10,000 with his bid, made payable to the order of the Commissioner of Public Works. The bids were opened Sept. 3, and the contract was awarded to A. J. Murphy, at his bid of $1,251 [illegible] for the Wright reduction furnace system. The deposit accompanying his bid was a certified check for $10,000, drawn on the First National Bank, of Chicago, by M. C. McDonald, who was reported to be a financial backer of the enter-

prise. As Mr. Murphy failed to give the required bonds for the carrying out of the work, although allowed an extension of time for so doing, the contract was cancelled and the city was put to the delay and expense of securing new bids. Under the terms of the call for bids, the deposit was forfeited, and in due course the City Controller presented the check for payment. In the meantime, however, Mr. McDonald had notified the bank to stop the payment of the check, and the bank obeyed his instructions. The question which is now agitating banks and city officials and contractors is whether the bank had any right to stop payment of a certified check.

The bank claims that the instructions from Mr. McDonald showed that there was a doubt as to the ownership of the money, and that it simply holds the money until the courts decide to whom it should be paid. It claims further that a certified check merely means that the bank certifies that the drawer of the check has the amount on deposit with the bank. The controller claims that when the check was certified and deposited Mr. McDonald had no right or property in it, and that it belonged to the city, as money, to be returned if the bidder fulfilled the requirements or to be retained by the city if he failed of this fulfillment. The controller also claims that the drawer of the check has no power to stop payment of that check when it has been certified. According to interviews reported in the newspapers, most bankers appear to agree with the controller's view of the case, and consider that the bank had no right to refuse payment. This would seem to be the correct interpretation, since in the opposite case the deposit of a check, asked for as evidence of good faith, would be no guarantee whatever and would afford no protection to the city. The matter is now before the courts, and the decision will be of wide interest and importance. In the meantime the controller has decided that until the decision is rendered no more certified checks on the First National Bank will be accepted as deposits on bids for city work.

THE LAW OF PARTY-WALLS has been lately interpreted by the Appellate Court of New York as follows: In the case of De Baun vs. Moore: A party wall, 85 ft. deep, formed the boundary between two properties, and for 48 ft. this wall was used for the mutual support of the two houses. The dispute arose as to windows in the remaining 37 ft. One party claimed that a party wall was necessarily a solid wall without openings of any kind, and that windows have no place in a party wall. The defendant replied that, assuming that the boundary did run through the center of a party wall recognized as such; the agreement at the time of purchase related to the wall as it then existed, and involved no stipulation that it should be changed by either party. Easements for light and air, said the defendant, are not recognized in this country as either granted or reserved by implication; but when a former common owner severs two properties, he impliedly reserves such uses of the property conveyed as are then being enjoyed for the benefit of the property retained; provided, such uses are apparent, and add substantial value to the property retained. Judge Hatch decided, that as there was no reservation in the deed for the preservation of the windows the plaintiff was entitled to use it at any time as a party-wall and block up the windows in such use. But Judge Hatch could find no ground upon which equity could compel defendant to close the openings. That must be done by the plaintiff if he chooses to build.

LECTURES ON MUNICIPAL ENGINEERING at the University of Nebraska are being attended by members of the city council, which body has changed the night for its meetings in order that its members may be free to go to the lectures. Others of the citizens are also attending the course, which is being given primarily for the benefit of the engineering students by Mr. Andrew Rosewater, M. Am. Soc. C. E., City Engineer of Omaha.

THE POWER OF THE LANGLEY AIR-SHIP was tested at Mount Holly, N. J., on Dec. 1, on the Medford Branch of the Pennsylvania R. R., under the personal direction of Prof. Elfreth Watkins, of Washington, D. C. The trial was devised to test the pulling power of the propellor when operated by a small gasoline engine. For this purpose the engine and propeller were mounted on a four-wheeled truck on the railway. The propeller blades were 4 ft. long and were made of strong steel tubing covered with canvas. At 350 revolutions per minute the car with its load, weighing nearly 4,000 lbs., was pulled along the track at a speed of about 5½ miles per hour, down a grade of about a foot to the mile but against a strong wind then blowing. When used in the air the estimated speed of these propellers will be 800 to 1,200 revolutions per minute; and Professor Watkins expressed himself as being surprised at the power shown by the machine, which exceeded his expectations. The aerodome, as it is called, is yet, however, in its experimental stage.

HIGH KITE ASCENSIONS, at Blue Hill, Mass., are recorded in "Monthly Weather Review," as follows: On Sept. 19, 1897, two self-adjusting Hargrave kites, with areas of 36 and 41 sq. ft., and five other kites of the same type and 22.9 sq. ft. area, lifted the meteograph to a height of 9,255 ft. above the ground, or 9,885 ft. above sea level. The temperature at the highest point was 37.6°, as against 63° at the Blue Hill Observatory. On Oct. 15, the meteograph was raised 11,716 ft. above sea level by a Lawson ribbed kite of 71 sq. ft. area, an adjustable Hargrave of 36 sq. ft. and two Hargraves of 22.9 sq. ft. area each. The temperature recorded at that height was 41°, as compared with 72° at the Observatory. In the first experiment the weight of 6,300 meters of wire out was 50 lbs., and the pull on the wire varied from 104 to 152 lbs., with the wind at the ground varying in velocity from 20 to 30 miles per hour. This wire is reeled in by a steam windlass at a rate varying from 0.5 to 2.7 meters per second, according to the strain on the wire. These experiments were made with a grant of money from the Smithsonian Institute and were conducted by Messrs. Rotch, Clayton, Sweetland and Ferguson.

WATER SUPPLY IN THE ARID REGIONS of Arizona is being arranged for by the Atchison, Topeka & Santa Fe Ry., on account of the expense of hauling water for the locomotives. The dams are being built to form large reservoirs. Two of these are masonry dams, and the third is a steel dam having an inclined face of steel plates supported by columns and bracing. The bottom plates are bent down vertically, the vertical portion being let into a groove cut in the rock.

THE TWIN LAKE IRRIGATION SCHEME has been receiving some attention of late in the Colorado papers. In response to our inquiries Mr. Fred. Warren, Engineer in Charge, of Pueblo, Colo., has sent us the following information on the subject: The general plan of the work is the storage of water in Twin Lakes, carrying the same for 165 miles through the Arkansas River to the headgate of Colorado Canal, by means of which it will be distributed to irrigators. The water in the Twin Lakes will be raised 10 ft. by means of a dam across Lake Creek, and provision made for drawing off 26 ft. of water. The reservoir site has an area of 2,175 acres, and the present maximum depth of water is 85 ft. A set of headgates, wholly of steel, will be built. It is expected that the work of construction will be started in the spring. The altitude of Twin Lakes is 9,200 ft., and the country to be irrigated is itself 4,000 ft., above sea level.

DAMAGES TO THE AMOUNT OF $5,000 have been awarded against the Ashland Water Co., of Ashland, Wis., on account of death alleged to have been caused by typhoid fever conveyed by drinking water furnished by the company. The attorneys for the company have made two motions in the trial court, one for the setting aside of the verdict and another, in case the first is denied, for a new trial, on the ground that the verdict was contrary to the law and the evidence. In case both these motions are denied the case will be carried to the State Supreme Court. The attorneys for the company maintain that the court was in error in admitting as testimony water analyses made long after the decedent contracted the disease; that the proof as to the immediate cause of death is not positive; and that the decedent knew, or ought to have known, as fully as the company, the condition of the water.

THE U. S. POST OFFICE DEPARTMENT is reported upon as follows, for the fiscal year ending June 30, 1897, by Postmaster-General James A. Gary: Total revenue, $82,665,462; total expenditures, $94,077,242; deficit, $11,411,779. This increased deficit, contrasted with $3,284,691, for the year 1896, is largely a reflex of depressed business conditions prevailing for the greater part of the year 1897. The money order system showed only 2% increase, as against 7% in the previous year; the registration income decreased 4%. On the other hand there was an increase of 16,000,000 lbs. in the weight of second-class matter, carried at a loss of more than 7 cts. per pound. The total weight of this class of mail, in 1897, was 365,000,000 lbs., as against 143,000,000 lbs. in 1888. This quantity cost for transport about $29,000,000 in the last year, with a postal revenue from it of only $3,000,000. A bill is now before Congress amending the rates charged for this class of mail. The inland mail routes now daily traversed aggregate over 470,000 miles; and the annual mileage for 1897 was about 421,000,000 miles. There were 71,022 post offices in the country; the railway mail service employed 7,602 persons, who handled 16,256,663 pieces of registered mail and 11,571,540,680 ordinary letters, etc., and separated, en route, 462,469,640 city letters. There was but one error in 11,960 pieces in distribution, as against one in 3,694 ten years ago. During the year 4,201,737,904 postage stamps, stamped envelopes and postal cards, of the value of $79,631,561, were issued to postmasters. In handling registered mail there was but one loss for every 22,840 pieces handled. The daily average of dead letters received at the department is 20,000 for every business day of the year.

A NEW METHOD OF BRAZING, which it is claimed will displace the flame method, is described in a circular issued by the Joseph Dixon Crucible Co., Jersey City, N. J. By this method the joint to be brazed is immersed for a few seconds in a crucible filled with molten spelter. The surfaces to be brazed are first painted with a flux and the adjacent parts with what is called an "anti-flux" or "brazing graphite," which is furnished by the Dixon Co. The company also makes a special form of crucible or bowl for containing the molten spelter. The new method is said to be especially adapted for use in the manufacture of bicycles.

NEW YORK STATE FOREST PRESERVES are reported upon by the State board. The last legislature appropriated $1,000,000 for the purchase of land in the Adirondack State Park, and the board has expended all but $170,000 of this sum. The State has so far accepted 250,000 acres at an average price of about $3.50 per acre. In addition to this territory the State already owned about 900,000 acres of Adirondack lands. About 1,500,000 acres still remain in private hands and it is stated that the State should secure at least one-half of this to complete the object for which the forest preserve was established.

BOOK REVIEWS.

ANALES DEL MINISTERIO DE FOMENTO DE LA REPUBLICA MEXICANA. Tomo X. Mexico, 1888. Paper; 9½ × 6¾ ins.; pp. 743; maps.

Though late in publication, this volume treats after a most detailed fashion of the earthquake of May 3, 1887, and the mines of Guanaquato. This last takes up the subject from a historical and geological standpoint and describes their operation, output, etc.

THE ELEMENTARY PRINCIPLES OF MACHINE DESIGN. Embracing the proportions of Connecting Rods, Piston Rods, and Pistons for Steam Engines, Cotter Joints, Screw Wrenches, etc. With Full Illustrations for Setting a Plain Slide Valve and Eccentric. By J. G. A. Meyer. Author of "Modern Locomotive Construction." The Industrial Publication Co., New York. Pamph. 5 × 7½ ins., pp. 92. 25 cts.

The object of this little book is to supply a beginner in the study of machine design with a simple and cheap work, which will lead him on by gradual and easy steps to an acquaintance with the more important departments of the subject. The very simplest language has been used. The book may be commended to young mechanics and to beginners in the drafting room.

MANUAL OF HYDRAULIC MINING.—For the use of the practical miner. By A. J. Van Wagenen, C. E., 2d edition, revised. D. Van Nostrand Co., New York. Cloth; 18mo.; pp. 95; $1.

As stated in the preface, this little book is written solely for the use of the practical and working miner, "who, while rarely deficient in common sense, is generally unacquainted with the principles of physics and more or less rusty in arithmetical methods." The book is written in a clear and simple style, no algebraic formulae are used, and some of the arithmetical examples, such as multiplication of decimals, are worked out in full. It may be commended as on the whole a fairly satisfactory and very brief presentation of the elements of the subject for the use of the practical miner, although there are some defects in statement of mechanical principles. For instance, the author defines momentum as "the quantity of force which a body in motion is capable of exerting when stopped suddenly." The statement following this definition to the effect that a certain jet of water "will hurl against a bank every second a force of 34½ tons," is, to say the least, inaccurate.

CONSTANTES PHYSICO-CHIMIQUES.—Par D. Sidersky, Ingenieur-Chimiste, Encyclopedie Scientifique des Aide-Memoire, publiee sous la direction de M. Lenaute, Membre de l'Institut. Paris: Gauthier—Villars et Fils, imprimeurs-editeurs; Masson et Cie, Editeurs, Libraires de l'Academie de Medecine. Paper; 7½ × 4½ ins.; pp. 207; illustrated; 3 francs.

In this work the author seeks to give, from his own experiments and from the best authorities available, the physical constants of many substances, with a special view to their practical application to industrial chemistry. The constants are the density, change of physical state, viscosity, capillarity, indices of refraction, calorimetry and photometry. For each of these constants, treated under separate heads, he illustrates and briefly describes the most exact and convenient processes for making the measurements; and in the tables he gives the results of observations made upon various substances. In his description of methods Mr. Sidersky selects those which are best suited to the industrial chemical laboratory, rather than those used by the medical profession; and he has added some experiments showing the application of these methods to the measurement of molecular weights. The author believes that a study of the constants here worked out will considerably facilitate research based upon physico-chemical measurements.

THE ESSENTIALS OF GEARING.—A Text Book for Technical Students and for Self-Instruction, Containing Numerous Problems and Practical Formulas. By Gardner C. Anthony, A. M., Professor of Drawing in Tufts College, etc. D. C. Heath & Co., Boston. Cloth, 7½ × 6 ins.; pp. 84, with 15 folding plates; $1.50.

This book is one of a "Technical Drawing Series," issued by the publishers, which includes "Mechanical Drawing" and "Machine Drawing" by the same author, and "Free-hand Lettering" by F. T. Daniels. It appears to be an excellent though very brief treatise for the use of students of drawing and machinery design as well as for the working draftsman. It is well indexed and is therefore suitable for a reference book. The author's method is to give a series of progressive problems, to be worked out on the drawing board, the execution of which will give the stud-

ent a fair knowledge of the theory of gearing. The folding plates at the end of the book are conveniently arranged so that they may be studied in connection with the text without having to turn over a page. The plate is folded on a blank page so that when unfolded it lies entirely beyond the right hand margin of the pages of the text. This is probably the best possible arrangement for a work of this kind. The plates themselves are fine specimens of drafting. We cordially commend the work to all students of the subject of gearing.

THE POWER CATECHISM.—Correct Answers to Direct Questions Concerning the Main Principles of Steam Engineering and the Transmission of Power. Compiled from the regular issues of "Power." Intended for special assistance in preparation for examinations, or where direct information is desired. The Power Publishing Co., New York. Cloth; 8vo.; pp. 226; $2.

The "Questions and Answers" column of the monthly journal "Power," edited by Mr. F. R. Low, has for many years been a mine of valuable information to its readers. The answers are usually remarkable for their clearness and simplicity of expression, being adapted to the needs of those of limited mathematical and technical knowledge, and at the same time are quite accurate. The volume before us is a compilation partly from these "Questions and Answers," and partly from a continued series of articles entitled "Power Catechism." For engine drivers, students and others who may like to have information concerning boilers, engines, shafting, belting, etc., in catechetical form this book should be found very useful. We have noticed only one serious error in looking over the book, that is the statement on p. 98 that in computing the heating surface of a tube its inner surface should always be taken, whereas the answer should be that the surface exposed to the fire is the real heating surface.

TRACE D'UN CHEMIN DE FER.—By Albert Dufor, C. E. Paris: Gauthier-Villars & Sons, and Masson & Co. Paper; 4½ × 7½ ins.; pp. 212; 3 francs.

The contents of this book describe those operations of a railway survey which in America would be included under the heads of reconnoissance and the preliminary survey, excluding location. In general, the purpose of the author has been to describe methods of work which must be adopted in unmapped countries, and which, he states, are little known by French engineers who are accustomed to have the aid of well executed maps in all the preliminary work of railway surveys made at home. The objects and methods of reconnoissance and preliminary surveys are described in some detail, and considerable space is also given to a description of the construction and operation of the various instruments most commonly used in work of this character. A large amount of space is devoted to describing the use of the tacheometer, or stadia, as it is more commonly called in America; rules are given for its operation, for recording the notes, and for making corrections, and the adjustments and handling of the instrument are described in detail. In its strong recommendation of the stadia for railway work and in the full description of the methods of using this instrument will be found the chief value of the book to American engineers.

AMERICAN AND OTHER MACHINERY ABROAD.—Being a Study of the European Field for the introduction of American Machinery. By Fred. J. Miller, M. Am. Soc. C. E., Editor "American Machinist." Press of the "American Machinist," 256 Broadway, N. Y. Cloth; 6 × 9 ins.; pp. 90.

For some time past the "American Machinist" has been publishing a series of articles dealing with the reception given American machinery in foreign countries. The monograph published under the above heading is a compilation of 13 letters written from London, Manchester, Glasgow, Brussels, Liege, Paris, Berlin and Moscow by Mr. Miller, during a recent European tour. In speaking of the publication in his preface he says:

It is nothing more than a record of some of the impressions gathered during a tour among foreign workshops in which machinery is built and used, and an attempt to show something of how such shops are conducted, how work is done in them, and, especially, what conditions American tools, now going abroad in such large numbers, have to meet in foreign lands.

The treatment of the topic thus outlined is most excellent, and the letters will afford interesting reading to any one and cannot fail to interest American engineers and manufacturers generally. Indeed, the success of American manufacturers in recent years in exporting the highest class of machine tools is a subject for national congratulation, and one of those "victories of peace," whose story is as interesting if read with an understanding mind as any tale of mediaeval warfare.

A FIELD MANUAL FOR RAILROAD ENGINEERS.—By J. C. Nagle, M. A., C. E., Professor of Civil Engineering in the Agricultural and Mechanical College of Texas. New York; John Wiley & Sons. Morocco; 4½ × 6¾ ins., with flap; pp. 394; 100 illustrations; $3.

There are already so many manuals for railway engineers which are reasonably satisfactory for all practicable purposes that one is bound to question the need of a new railway field book. Beyond this we find little to urge against the present publication. In the first three chapters the author treats of reconnoissance, preliminary surveys and location. These chapters contain instructions regarding the organization of the field corps and the equipment required, descriptions of the construction and adjustment of the various necessary instruments, and, of course, rules and methods for laying out the line, taking topography, and recording the surveys. Chapter IV. discusses transition curves, the method adopted being that presented in Prof. C. L. Crandall's manual on the Transition Curve (Eng. News, Nov. 9, 1893). Both exact and approximate methods for locating transition curves are given. Chapter V. discusses frogs and switches and their location, and chapter VI. takes up the work of construction, giving methods for calculating earthwork and for doing various other parts of the actual construction work. In all there are 26 tables, including one on transition curves, and besides there is a long list of trigonometrical and miscellaneous formulas given. The publisher's work on the book is good.

THE STRENGTH OF MATERIALS.—A Text-Book for Manual Training Schools. By Mansfield Merriman, Professor of Civil Engineering in Lehigh University. New York, John Wiley & Sons. London, Chapman & Hall, Ltd. 12mo, cloth, pp. 124. $1.

Prof. Merriman is well known to our readers as the author of treatises on hydraulics, mechanics of materials, roofs and bridges, higher mathematics, etc. These works have all been of the highest class, suitable for advanced grades of instruction in engineering schools. The present work is of an entirely different order, being strictly elementary and suited to students who have had no higher training in mathematics and elementary physics than is given in most high schools. It might be supposed that an author like Prof. Merriman, who may almost be said to think in the language of the higher mathematics, would scarcely find it possible to write a work on strength of materials in such a style that it may be easily comprehended by a boy in a manual training school, but the fact is he has succeeded admirably. In the faculty of concentrating a great deal of information on a somewhat abstruse subject into small space, and at the same time using the clearest and purest English, we think he is without a superior among American engineering writers. We quote from the preface as follows:

The attempt is made to give a presentation of the subject of the strength of materials, beams, columns, and shafts, which may be understood by those not acquainted with the calculus. . . The author has had in mind the students in the higher classes of manual training schools, and it has been his aim to present the subject in such an elementary manner that it may be readily comprehended by them, and at the same time cover all the essential principles and methods. All the rules for the investigation and design of common beams, including the subject of moment of inertia, are here presented by simple algebraic and geometric methods. No Greek letters are used and algebraic expressions are made as simple as possible.

Problems for students to solve are presented and it should be strongly insisted that these should be thoroughly and completely worked out.

In a somewhat careful examination of this little book we find it excellent throughout, excepting a trifling number of minor inaccuracies. On p. 12 the author says:

The factor of safety was formerly much used in designing, but it is now considered the better plan to judge of the security of a body under stress by reference to its elastic limit.

A more correct statement, we think, would be that the factor of safety is still used, and is likely always to be used in certain classes of designing, and that the determination of the elastic limit is so uncertain that this limit is not as good a criterion of the strength of some materials as is the ultimate strength taken in conjunction with the ductility. The author himself uses the factor of safety in his problems on iron pipes, on p. 115, and he would not be likely to use the elastic limit in designing structures of cast-iron.

On p. 15 it is stated that in short bars in compression failure usually occurs by oblique shearing. It should also be stated that in ductile materials it may occur by bulging.

BALDWIN LOCOMOTIVE WORKS.—Illustrated Catalogue of Narrow-Gage Locomotives, adapted especially to a gage of 3 ft. 6 ins. Burnham, Williams & Co., Philadelphia, Pa. J. B. Lippincott Co., publishers. Cloth. 9 × 6 ins. 450 pp., profusely illustrated.

While this is technically a trade catalogue, the useful and interesting character of its contents, its illustrations and the manner in which these are presented lead us to review it more fully than is possible in the space usually allotted to trade publications. The first part of the volume is devoted to the full and interesting history of the Baldwin Locomotive Works, from their foundation in 1831, which was published separately some time ago, and was then noticed in this journal. The subject of narrow-gage locomotives is then taken up, and a system is illustrated and explained which, it is believed, will be found suitable for all ordinary service requirements. The key to this system seems to be the use of patterns which admit of modifications to suit the views of railway managers and the manufacture of all important parts from most accurately made gages and templates. As a result, local preferences can be met; the parts of engines of the same class are interchangeable with each other, and parts needed for repairs can be readily supplied. The cost of repairs is thus reduced to a minimum, and inconvenience and delay are avoided. The hauling capacity of each type of locomotive is given, as based upon actual work performed. The general specifications follow for the physical tests of all materials used in construction, and these specifications form one of the very valuable features of the publication in their detail, and in the full directions given for ordering locomotives of any desired class. These directions are illustrated, so that no mistake can be made as to what is meant. The class designations, for 18 classes of locomotives, illustrate the engine and give the dimensions, weights and traction power of the several patterns. The important parts of these locomotives are also shown and explained, along with the methods of operation, treatment and repairs. Rack and adhesion locomotives and switching engines are included and the fuel economy and general results obtained by the use of compound locomotives is very fully discussed and results are given from actual practice.

The copy of the catalogue sent us is the "Japanese Edition," issued for Frazar & Co., of Yokohama, Japan. It contains full instructions for cabling for duplicate parts and a specially adapted code for this purpose. This code is very full and is supplemented by a great number of illustrations showing in detail all the important parts of the locomotives referred to. Aside from its value as a technical production, this publication is typical of the enterprise of one of the greatest of American manufacturing establishments and shows a full appreciation of the best methods of introducing these manufactures into foreign countries.

THE WORLD'S RAILWAY.—Historical, Descriptive and Illustrative. By J. G. Pangborn. New York: The Angus Sinclair Co., 256 Broadway. Leather; 4to.; pp. 164; about 300 illustrations; $7.50.

Within the past two or three years there has been evidence of much public interest in railway history, and one result of this has been to bring out the fact that it is very difficult to follow up the various stages of this history owing to the loss of many valuable records through neglect and carelessness and through failure to realize the importance of these records. In view of this fact the book before us has a special and permanent value apart from its very interesting character, since it gives in a compact yet comprehensive manner the history of the railway and the locomotive for about 200 years. It commences with Sir Isaac Newton's suggestion, in 1680, that Hero's reaction steam engine might be applied to purposes of propulsion, and describes the early engines of Cugnot (1769), Murdoch (1784), Trevithick (1800), Oliver Evans (1804), Blenkinsop (1812), Hedley (1813), Stephenson (1816 to 1829), Seguin (1827), and numerous others, including many of the early American locomotives of Stevens, Rogers, Cooper, Winans, etc., and those built in England for American railways. The history is then followed along year by year. The development of the railway and of the locomotive are followed out together in a most interesting and instructive manner, with much incidental matter as to historical events, the construction of lines of historic importance, modifications in locomotive design, and the development of track, rolling stock, etc. The history itself is brought down to 1860, in which year Ramsbottom introduced track tanks on the London & Northwestern Ry., and Beugmont introduced powerful eight-coupled engines on the Paris, Lyons & Mediterranean Ry., these engines having cylinders 21¼ × 22 ins., with the piston rods extending through the front covers, the guides being in front of the smokebox and the connecting rods (outside) reaching back to the front axle. The author states that the greater portion of the work has been devoted to the earlier periods of evolution and progress, in the belief that these are the more instructive and valuable in showing the steps which have led up to the modern development which is now pretty well familiar to the present generation.

The illustrations form one of the most valuable features of the work, for though they are nearly all tinted reproductions of water-color drawings, they are very accurate and are drawn with sufficient care and clearness to show the details of the exterior parts, even to the arrangement of valve gear in some of the foreign engines which have their gear outside the wheels. In showing the general style and peculiarities of the old engines and their general appearance as compared with modern engines, this class of illustration is very successful, more so in fact than any number of general and detailed line drawings, since they show just what these engines look like in service, while the figure of the engineman on each locomotive gives at once a scale which enables the reader to realize the sizes of the engines. There is one of these illustrations of locomotives on every page, and on nearly every page is also a reproduction of a pen and ink sketch of an engine, a car, or a type of track construction, together with portraits of the great engineers and locomotive builders. While the letter-press brings the history up to 1860, the illustrations continue it to 1893, including the monster duplex-compound engines of the Mexican Central Ry., the engines of the "Empire State express," and the "Director General" of the Baltimore & Ohio R. R., exhibited at the Columbian Exhibition.

The writer of the book will be remembered as the special agent of the B. & O. R. R. who had charge of the wonderfully interesting historical exhibit made by that company at the Columbian Exhibition, and when it was determined to place this collection in the permanent Field Columbian Museum, a commission was appointed, with Mr. Pangborn at its head, to visit every country in the world where the railway has penetrated, and to collect material for the museum. A few pages are devoted to the work of this commission. The book is beautifully printed on heavy paper, and has an extensive index which is very useful for purposes of reference.